



403401

PRELIMINARY ASSESSMENT

AMERICAN FORK CANYON

**PACIFIC MINE
MARY ELLEN GULCH MINE
LOWER BOG MINE**

UINTA NATIONAL FOREST

PLEASANT GROVE RANGER DISTRICT

June 1994

PRELIMINARY ASSESSMENT

UPPER AMERICAN FORK CANYON

UINTA NATIONAL FOREST
PLEASANT GROVE RANGER DISTRICT

PACIFIC MINE, LOWER BOG MINE, AND MARY ELLEN GULCH MINE

PREPARED BY:



REVIEWED AND RECOMMENDED BY:

DISTRICT RANGER



RESOURCE ASSISTANT



EXECUTIVE SUMMARY

PACIFIC, LOWER BOG, AND MARY ELLEN MINES AMERICAN FORK CANYON, UTAH

The Pacific, Lower Bog, and Mary Ellen mines are located on National Forest System lands on the Uinta National Forest. Each mine has associated tailings piles with ground water running out of the mine adits. This water has been tested periodically, and is known to contain elevated levels of copper, zinc, and cadmium.

The area near the Pacific mine is used by recreationists. OHV (Off Road Vehicle) use occurs on the tailings pile of the Pacific mine. The Lower Bog and Mary Ellen mines are less accessible to publics; however water from these adits still enter the North Fork of American Fork creek.

The Uinta National Forest recommends mitigation and reclamation to varying degrees at each site. This Preliminary Assessment makes no effort to recommend specific techniques. Rather, the P.A. is written to give the reader an overview of the situation at each site along with a brief history, ownership, and condition of sites.

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Lidstone and Anderson, Inc, February 3, 1993

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PART I

General Site Information
and
Source and Waste Characteristics



photo circa 1910
pacific mine

LOWER BOG MINE

PACIFIC MINE

Map made, edited, and published by the Geological Survey

Control by 1920

Topographic map and aerial photographs by multiple methods

Base map by aerial photo 1950; 1:50,000 scale

Revised by ground survey 1957; 1:50,000 scale

10,000 foot contour interval; 1:50,000 scale

1:50,000 scale; 1:50,000 scale

1:50,000 scale; 1:50,000 scale

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1:50,000 scale; 1:50,000 scale

1:50,000 scale; 1:50,000 scale

SCALE 1:24,000

CONTOUR INTERVAL 40 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLETES WITH NATIONAL MAP ACCURACY STANDARDS

FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80219 OR RESTON, VIRGINIA 22092

A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

BRIGHTON, UTAH

NE 1/4, SEC. 10, T. 37 N., R. 10 E.

1955

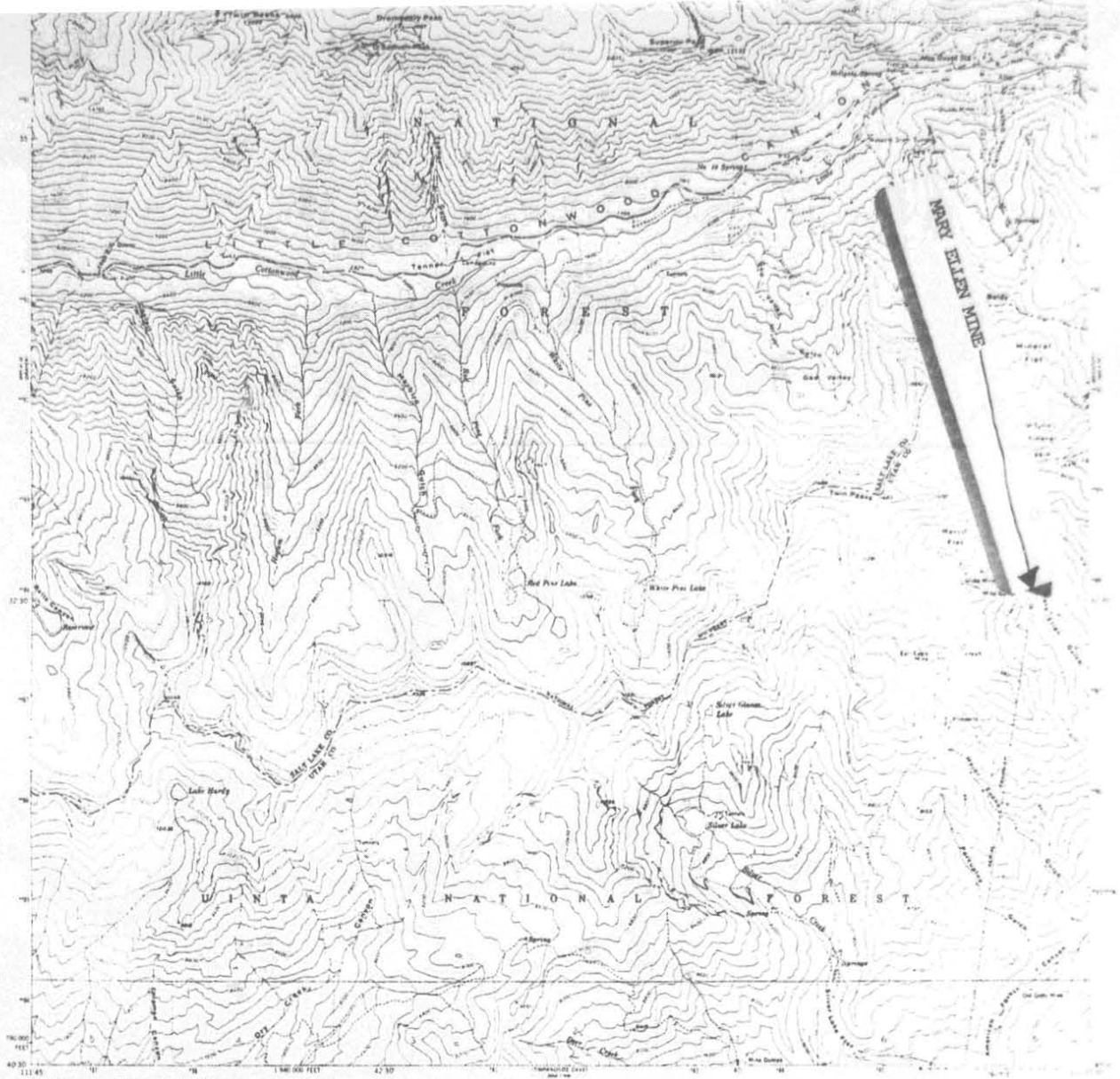
REVISION 1955

AND 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BRIGHTON QUADRANGLE
UTAH
15 MINUTE SERIES (TOPOGRAPHIC)





Map made, noted, and published by the Geological Survey
Control by USGS

Topography from aerial photographs by multiple methods
Aerial photographs taken 1950 Field check 1955
Elevation projection 1927 North American datum
10,000 feet and based on local coordinate system, control zone
Control zone lines indicate approximate locations
Unpublished elevations are shown in brown
1000 meter intervals Topographic Map and Text,
page 12, sheet 10, 10, 10

Revisions shown in brown (except from aerial photographs taken
1975) The photographs are not available
There may be private landings within the boundaries of
the National Forest shown on this map

To place on the projected North American Datum 1983
move the projection lines 8 meters north and
65 meters west as shown by dashed center lines

THIS MAP COMPLETES WITH NATIONAL MAP ACQUISITION STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



DROMEDARY PEAK, UTAH

NAD 83 - WILLIAMS 75

1955

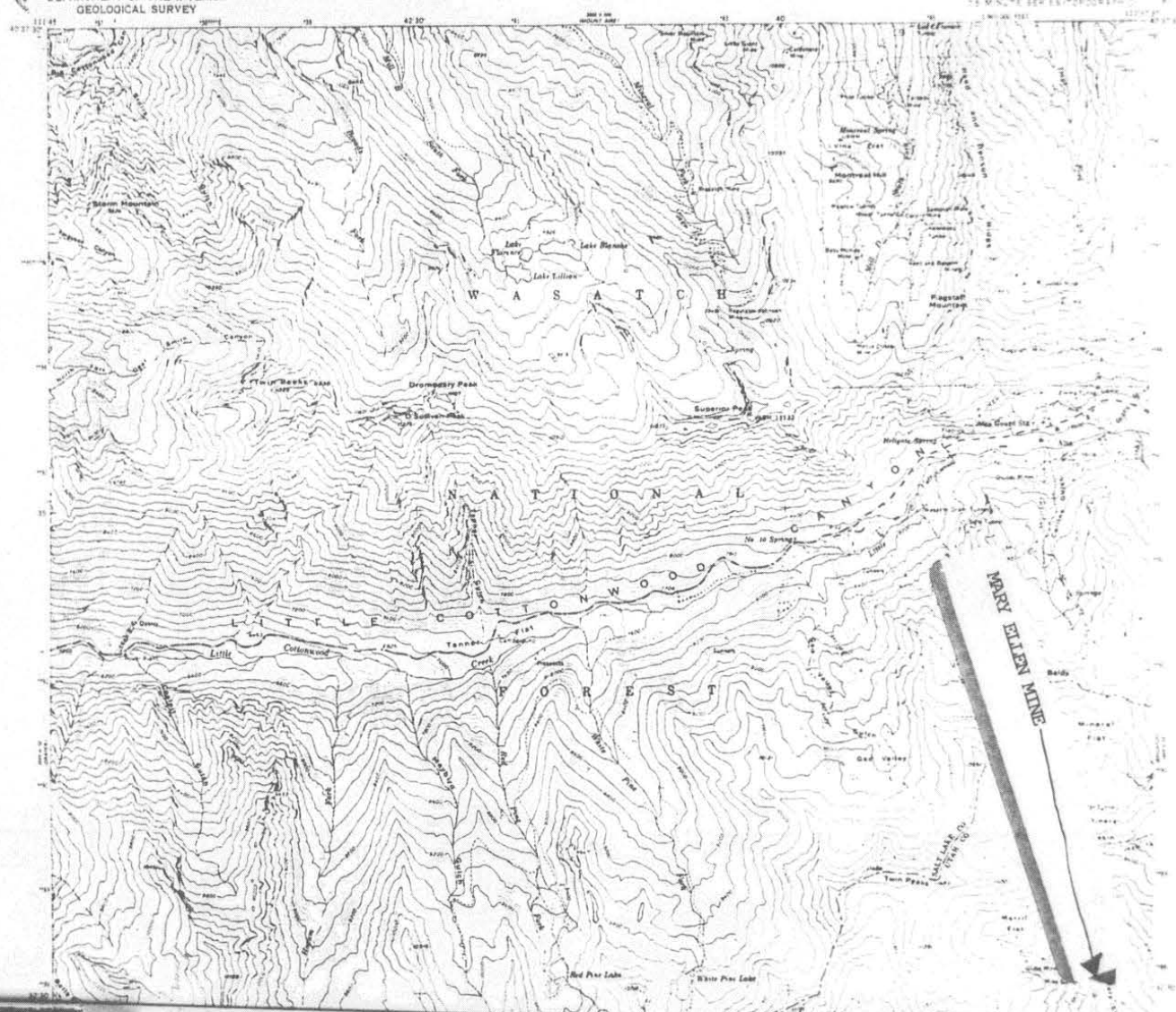
PHOTOGRAPHED 1975

1983

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DROMEDARY PEAK QUADRANGLE

7.5 MINUTE SERIES



GENERAL SITE INFORMATION

CERCLIS ID NUMBER:

UTD 988074951

SITE NAME AND LOCATION:

The site has been identified and will be referred to as the American Fork Mining District Site which is composed of three separate locations which are in close proximity to each other. These sites include the: Mary Ellen Gulch mine and tailings (MEG), Lower Bog mine and tailings (LB), and Pacific mine and tailings (PM). General location is in Utah County, in the Upper American Fork Canyon area. The MEG mine is located in Township 3 South, Range 3 East, NW1/4 of SE1/4 Section 20. The Lower Bog Mine is in Township 3 South, Range 3 East, SW1/4 of SE1/4 Section 16. The Pacific Mine and Tailings are located at Township 3 South, Range 3 East, NW1/4 of SE1/4 Section 22. All legal descriptions are Salt Lake Based Meridian (SLBM).

Ground water is present in all three mines. The water is exposed to mineralized rock, spent ore, and or tailings changing the chemical composition of the water (Lidstone & Anderson, Inc 1993). In the case of the three mines, the water runs out of the adit across tailings piles and into the American Fork River. In addition to containing trace elements picked up in the mine shafts, except at the Lower Bog Mine, the water picks up more contaminants as it passes through the tailings piles. Precipitation events also contribute to the pollution of the American Fork River through surface run-off from the tailings. In both the Pacific and Lower Bog situations, tailings piles at both sites are within 10 feet of the North Fork of American Fork river. This close proximity to surface water allows a high potential for contamination to occur to the river during and after most precipitation events.

The area surrounding the three sites is used throughout much of the year by outdoor enthusiasts. Recreational opportunities exist throughout the area including camping, fishing, hunting, off road vehicle use, and exploring. The ability for people get close to and travel virtually unrestricted through old mining operations appeals to many people. The area has a rich mining history that attracts people to it. Unfortunately, people who visit these sites are exposing themselves to more than just the appeal of the area.

Public access to the effluent and tailing piles is generally unrestricted particularly at the Pacific mine. Efforts were made to fence the area but were unsuccessful in restricting all publics from being exposed to the area. The tailings pile at the Pacific Mine is used by Off Highway Vehicles (OHV) as a hill climb and OHV play area.

The Lower Bog mine is less accessible, requiring a short hike or four wheel drive to get close enough to make the 200 yard hike to the foot of the tailings pile. The Mary Ellen Gulch mine is on private land and vehicle access requires travel with high clearance vehicles.

Exposure to the sites has not been directly linked to any health problems however that possibility exists.

TYPE OF FACILITY:

The three sites are facilities associated with early 20th century hard rock mining claims. Silver, Iron ore, and gold were all mined at these sites (Keech). Along with the mining activities, milling also occurred on site, leaving tailing piles at the Pacific and Lower Bog mines (See Attached Photos). Ground water is flowing out of each of the three mine adits at varying flow rates. The ground water is exposed to elevated levels of Zinc, Cadmium, Copper, and Lead (See Appendix A). In addition to the contamination that occurs within the adit, in the case of the Pacific and Mary Ellen mines, the same effluence flows over mine tailings with similar elevated elements.

TYPE OF OWNERSHIP:

MARY ELLEN GULCH MINE: (Survey Number L57, Plat Index Number 392) Sold by Mann Enterprises to William D. Schnack on 8/20/1987. This mine is privately owned and currently not in operation. The water that flows out of the mine adit flows across mine tailings directly into the Mary Ellen Gulch tributary of the American Fork River. Shortly after the adit water enters the Mary Ellen Gulch tributary, (within 300 feet) it enters onto National Forest System lands.

PACIFIC MINE: (Survey Number 5361, Plat Index Number 491 originally known as the Blue Rock #2 claim) the Mine is owned by the Euro-Nevada Mining Corporation, Inc. 6121 Lakeside Drive, Suite 240, Reno, Nevada 89511, (702) 825-8890. The majority of the tailings pile and settling pond exist on National Forest System land.

LOWER BOG MINE: (Survey Number 5422, Plat Index Number 451) Originally patent 6/24/1910. Last owner Lorraine B. Jack et al who sold the land to United States of America on 10/14/1966 and is now National Forest System lands.

SITE STATUS:

MARY ELLEN GULCH MINE: The Mary Ellen mine is currently inactive however, the Globe mine which is adjacent (upstream) to the Mary Ellen Mine is active.

PACIFIC MINE: The Pacific mine is currently inactive.

LOWER BOG MINE: The Lower Bog mine is currently inactive.

YEARS OF OPERATION:

Each of the mines have been reviewed by Uinta National Forest Archeologist for cultural and historical significance and are all eligible for National Historic Register status.

MARY ELLEN GULCH: The Mary Ellen gulch mine was located in 1870. A patent was filed for operation in 1876. Activity occurred periodically through 1959.

PACIFIC MINE: Formally known as the Blue Rock #2 was located in 1903. At this time, there was evidence of three tunnels prior to location. Activity at this

Pleasant Grove Ranger District
November 04, 1993 1040 hours
Tim Garcia & Paul Skabland

Discharge rates were estimated and compiled from Lidstone & Anderson, Inc water resource and Environmental Consulting

$$pH = 5.1$$

TDS = 120

$$Z_A = 660$$
$$C_d = 14$$
$$\rho_b = 10$$
$$C_u = 30$$
$$F_c = 9,100$$

Portal

44.5 GPM DISCHARGE

70 feet

TAILINGS PILE BEGINS

(Gravel and iron waste)

(Projected Tailings Pile)

69 feet

SLOPE OF TAILINGS BEGIN

27 feet

27 feet to bottom of tailing slope

27.2 foot elevation drop to bottom of tailings.

12 foot

TAILINGS HEAD WIDTH

22 to foot elevation

40 feet

END OF TAILINGS

10 foot elevation

12 feet

42 feet

11 (cont.)

AMERICAN FORK RIVER

3.3 CFS (STREAM WIDTH NOT TO SCALE)

WATER DISCHARGE NOTES:
Discharge rates were estimated and compiled from Lidstone & Anderson, Inc. water resource and Environmental Consulting
AMERICAN FORK HYDROLOGY AND WATER Q
FEBRUARY 03 1993

$pH = 5.1$
 $TDS = 120$
 $Zn = 660$
 $Cd = 14$
 $Pb = 10$
 $Cu = 30$
 $Fe = 9100$

6900 ft^2

 6900 ft^2

3.3 CFS (STREAM WIDTH NOT TO SCALE)

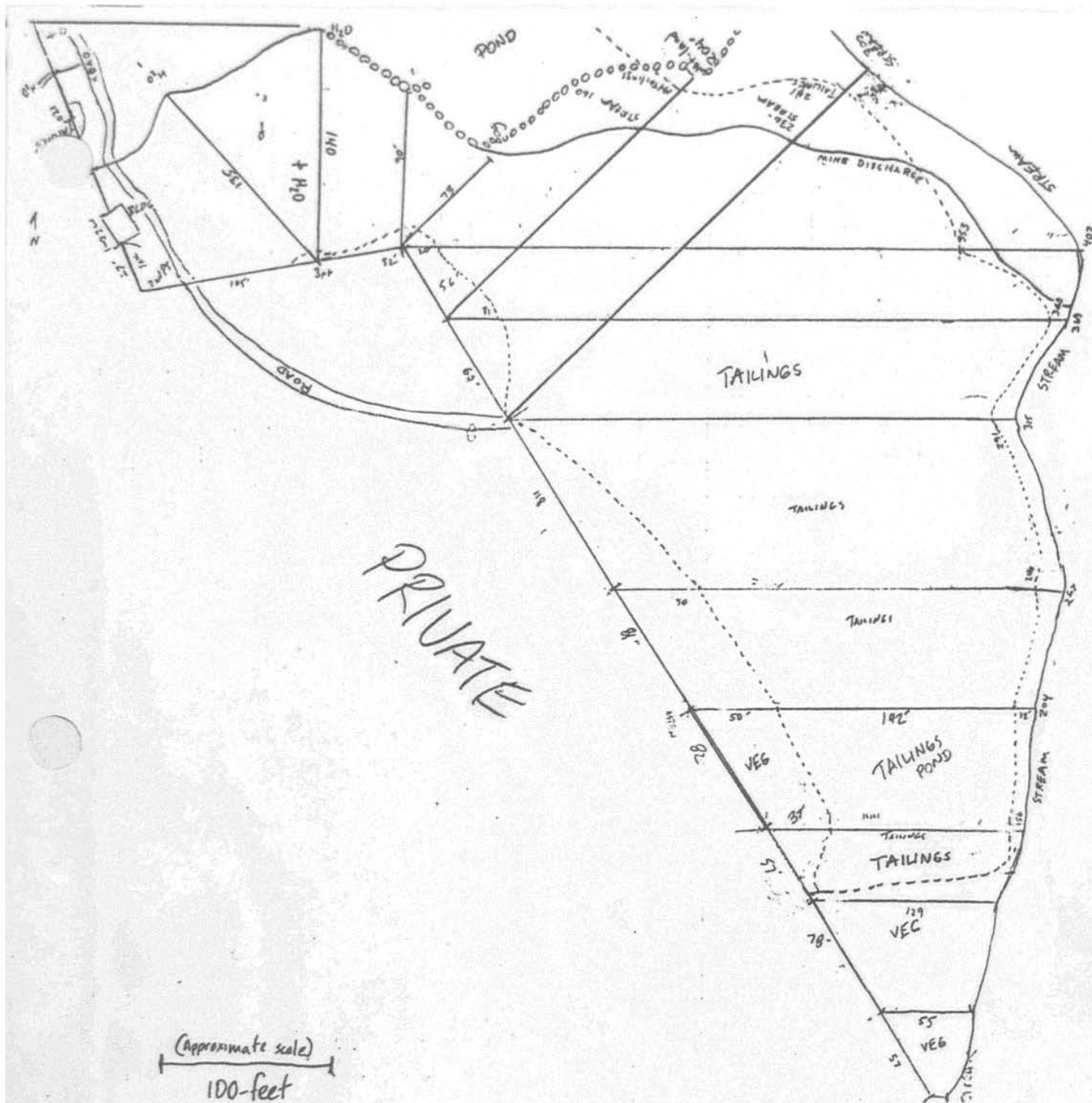


(Approximate scale)

20 Feet

± 0.2 GPM DISCHARGE

KN 44.5 GPM DISCHARGE



Pacific Mine tailings pond
 November 5, 1993
 Tim Garcia & Jill Schroeder

--- = tailings perimeter
 ○○○○ = wet lands

120,000 ft²

20 40 60 80 100 120 140 160 180 200 220 240 260 280 300



PACIFIC MINE 6-94
Adit discharge running through
tailings.



PACIFIC MINE 6-94
Beaver pond (foreground)
Pacific tailings

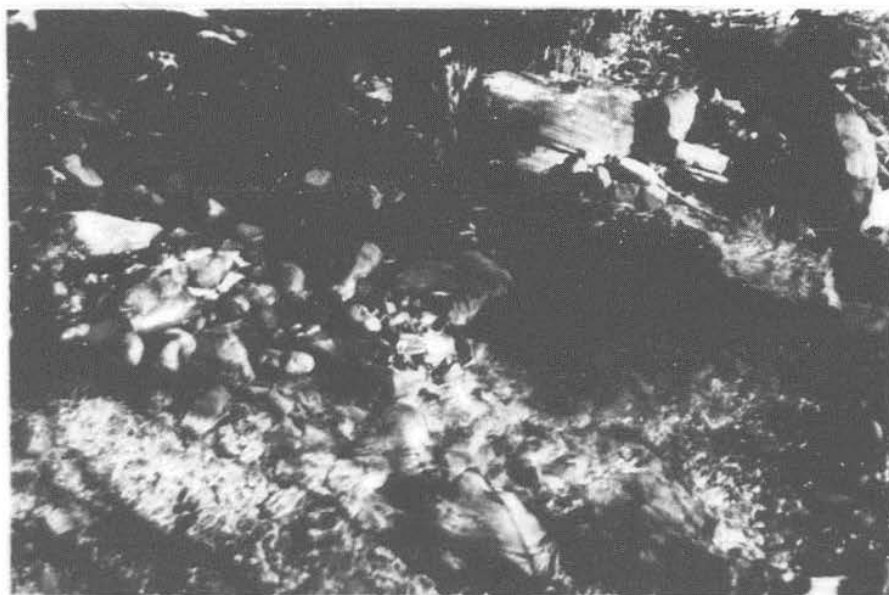


LOWER BOG MINE 10/93

ADIT discharge (right) entering North
Fork American Fork stream.
Tailings pile (left)

LOWER BOG MINE 10/93

"Yellow Boy" discolored sediment
entering North Fork American Fork River



mine was at it's height between 1910 and the late 1940's. There has been a resurgence of interest in making further explorations of this mine in the last decade by it's current owner; however no significant work has been done since the 1940's.

LOWER BOG: The Bog mine was located in 1895 by Ed Hines. Initial surveys were conducted in 1905 with actual work beginning in 1914. Active mining occurred through the 1940's and finally operations shut down in the late 1940's. Some prospecting occurred later in the 1970's however the majority of activity occurred between 1914 and the late 1940's

OWNER/OPERATOR INFORMATION:

MARY ELLEN GULCH: William D. Schnack c/o Associated Title Co., P.O. Box 478, Salt Lake City, UT, 84110-0478, Attn: Lyle Swenson

PACIFIC MINE: Euro-Nevada Mining Corporation, Inc. 6121 Lakeside Drive, Suite 240, Reno, Nevada 89511, (702) 825-8890 owns the mine and some tailings however, the majority of the tailings pile and settling pond exist on National Forest System land.

LOWER BOG: United States of America, National Forest System Lands.

ENVIRONMENTAL SETTING:

MARY ELLEN GULCH: The Mary Ellen Gulch mine is located at approximately 9,000 feet above sea level. Dominant vegetation types include upper elevation riparian, alpine spruce/fir type and high elevation mountain brush.

PACIFIC MINE: The Pacific Mine is located in the bottom of the North Fork of the American Fork Canyon at approximately 7800 feet AMSL. Vegetation consists of mixed conifer stands to the west and riparian vegetation skirting the east perimeter of the tailings pile and settling pond. The North Fork of the A.F. river runs within 10 feet of the tailings around the east side of the mine tailings area.

LOWER BOG: The Lower Bog is located along a stream corridor consisting of associated high elevation riparian vegetation types. The adit is in a high elevation mountain brush zone.

APPROXIMATE SIZE OF SITE:

MARY ELLEN GULCH

PACIFIC MINE: Operations at the Pacific mine cover an area of approximately 120,000 square feet. The majority of this area is used as a tailings and settling pond. The average depth of the tailings around the area is estimated at approximately five feet. The total volume of the tailings has been estimated at 600,000 cubic feet of tailings containing elevated levels of zinc, cadmium, lead, and copper. There are remains of buildings associated with the Pacific mine operation however; no intact structures are present.

LOWER BOG: Groundwater discharge and tailings pile make up the facility at the Lower Bog mine. The area associated with the mine involves about 6900 square feet. The average depth of the tailings is approximately 10 feet, with total volume being approximately 69,000 cubic feet. There are no facilities associated with the Lower Bog mine.

SOURCE AND WASTE CHARACTERISTICS:

SOURCE TYPES AND LOCATIONS:

MARY ELLEN GULCH: Groundwater discharge is the primary source of contamination in the Mary Ellen Gulch location. Groundwater surfacing from the adit contains elevated levels of zinc, iron, copper, lead, and cadmium. The Mary Ellen Gulch Mine is located along a south east flowing tributary drainage to the North Fork of the American Fork River at an elevation of 9,100 feet. The site has several portals, tailings and waste rock piles. The North portal has a pH of 5.95, while the south portal has a 7.2 pH. The North Portal discharges 70 GPM (Gallon Per Minute) with the south portal discharging only 2.5 GPM (Lidstone & Anderson 1993).

PACIFIC MINE: There are two major waste characteristics involved at the Pacific mine site. The first is the extensive tailings pile and settling pond associated with past mining activities. Dust transported by wind and precipitation run-off are both causes for the spread of these tailings from the site. Tailings and the settling pond are both within a distance of 10 to 50 feet from the American Fork river. The second Source of pollution is ground water discharge from the Pacific mine adit itself. 144 GPM discharge with a pH of 6.5 was measured from the Pacific mine portal with elevated levels of lead, zinc, copper, and cadmium (Lidstone & Anderson 1993).

LOWER BOG: The Lower Bog mine has an elevation of about 8500 feet. The site consists of a single bedrock opening, tailings dump, and miscellaneous spoil piles. Discharge from the adit is approximately 44 GPM with "yellow boy" or hydrous iron oxide deposits around the area of discharge. pH levels were measured at 5.1 with total dissolved solids at 80 parts per million (PPM). 1992 samples indicate elevated levels of iron, cadmium, zinc, copper, and lead. Discharge from the mine adit flow boths around both sides of the tailings located below the mine opening (Lidstone and Anderson 1993).

HAZARDOUS SUBSTANCES PRESENT:

The following elements identified exceed aquatic standards:

MARY ELLEN GULCH: Elevated levels of zinc and iron are present (Mangum, 1988).

PACIFIC MINE: Elevated levels of lead, cadmium, zinc, and copper are present (Mangum, 1988).

LOWER BOG: Elevated levels of lead, cadmium, zinc, copper, and iron are present (Mangum, 1988).

Testing of each site has occurred on several occasions. Results of these tests can be seen in section IV of this text.

GROUND WATER USE AND CHARACTERISTICS

General Narrative:

Sources of contamination are poorly contained. The tailings are not enclosed allowing infiltration to freely occur. Ground water that is discharged from the mine adit is being discharged already contaminated (Mangum, 1988). The source is less likely to contaminate ground water than it is to contaminate near by surface water. The waste quantities at any one of the three would not be considered particularly large; however the waste at all three sites combined would be considered large.

Annual precipitation for all three areas is approximately 40 inches annually. Much of the precipitation comes in the form of snow between the months of November and April. Infiltration rates at all three areas would not be considered exceptionally high; but rather should be considered average with none of the areas having evidence of karst terrain.

PRIVATE WELLS WITHIN 4 MILES: There are no known private wells within four miles of any of the three mines sites identified. The areas downstream from the Pacific mine particularly is a popular site for camping and fishing. Campers, upon occasion may still drink directly from the American Fork River directly below the Pacific mine tailings.

SURFACE WATER USE AND CHARACTERISTICS

DISTANCE TO NEAREST SURFACE WATER:

MARY ELLEN GULCH: The closest surface water to the Mary Ellen adit is within 30 feet. The effluent from the adit flows down across mine waste and directly into the Mary Ellen Gulch tributary of the American Fork River.

PACIFIC MINE: The tailings pile and settling pond is within 10 feet of the American Fork River. During precipitation events, run off will flow directly across the tailings and into the river. The effluent from the Pacific mine adit flows into a wetland area created by beaver activity. This beaver pond captures some of the contaminants preventing a strong solution from entering the American Fork stream channel (Lidstone & Anderson, 1993). However there is evidence that some elements enter the stream.

LOWER BOG MINE: Tailings from the Lower Bog mine are within 3 feet of the main channel of the American Fork River. In addition to the exposure of surface water, adit discharge runs over and around the tailings. Either adit discharge or springflow flows beneath the tailings pile and enters the stream from beneath the mine tailings.

SURFACE WATER BODY TYPES WITHIN 15 DOWNSTREAM MILES

Tibble Fork Reservoir is approximately 7 downstream miles from the lowest site (Mary Ellen Gulch). It is used as a flood control structure. Water collected there is also used for agricultural irrigation in the Utah County area. No evidence has been collected indicating the contamination of Tibble Fork

Reservoir as a result of these sites. Evidence in fact shows little effects of the contaminants less than a mile down stream from the lowest source.

FISHERIES WITHIN 15 DOWNSTREAM MILES:

All three mines are located in the American Fork drainage. The American Fork river, including Tibble Fork Reservoir is a put and take fishery managed primarily for rainbow trout. Secondary management is for brown and cutthroat trout. The Utah Division of Wildlife Resources (DWR) stocks approximately 35,500 fish a year in the stream reach from Mary Ellen Gulch to the mouth of American Fork Canyon, which is a distance of approximately 11.6 stream miles.

No studies have monitored fish downstream of the mines for contaminants. It is not known if, or at what levels fish retain contaminants from the mines. Many of the planted fish do not overwinter and spawn. A small, but important native cutthroat trout population does overwinter and spawn in this drainage. The majority of fish caught in the American Fork river have been in the drainage less than one year. Fisherpersons commonly keep and eat the fish they catch.

Quantifying the actual number of recreation fishing hours on the American Fork river is difficult, but the DWR manages the American Fork river as a "heavy use" area and has a goal of 500 angler-hours/acre/year.

Numerous log structures designed to enhance fish habitat have been installed along the upper reaches of the American Fork River. Rainbow trout congregate in the pools below these structures and encourage fishing below the discharge of the three mines. Tibble Fork Reservoir was built as a sediment trap and traps sediment associated with the discharge from the sites. Dissolved pollutants may travel below the reservoir.

SENSITIVE ENVIRONMENTS AND WETLANDS WITHIN 15 DOWNSTREAM MILES:

SOIL EXPOSURE CHARACTERISTICS:

General Narrative

Soil effects are localized and restricted to immediately around each of the three sites. Little evidence has been gathered indicating effects to the soil resources.

AIR PATHWAY CHARACTERISTICS:

General Narrative

Effect of the air pathway is localized at all three sites. Localized wind at each site has the potential to transport contaminated tailing dust within a close proximity of each site. The threat of air pathway contamination is not fully known. Dust from these areas has been witnessed by individuals and seems to be the only threat to the air pathway.

LOCATIONS OF SENSITIVE ENVIRONMENTS WITHIN 4 MILES:

ACREAGE OF WETLANDS WITHIN 4 MILES:

Wetlands

The entire watershed within a radius of 1/4 and 1/2 miles of the Pacific mine drains into the North Fork of American Fork Creek. A wetland approximately 2 acres in size is associated with a beaver pond in the stream. The beaver pond is within 1/4 mile of the Pacific Mine. Approximately 4 acres of sensitive environments (riparian areas) exist along the stream channel. Two acres in the 1/4 mile radius and 2 acres within the 1/2 mile radius. No other wetlands or sensitive environments occur within 1/2 mile of the Pacific Mine.

	ONSITE	1/4 mi.	1/2 mi.
Wetlands	0.1 acres	2 acres	0 acres
Sensitive Env.	0.2 acres	2 acres	2 acres
Total	2.1 acres	4 acres	2 acres

PART II

Preliminary Assessment Scoresheet

APPENDIX A

OMB Approval Number: 2050-0095
Approved for Use Through: 1/92

PA Scoresheets

Site Name: American Fork Canyon

CERCLIS ID No.: UTD 988074951

Street Address: _____

City/State/Zip: _____

Investigator: Timothy Garcia

Agency/Organization: USDA Forest Service

Street Address: 88 West 100 North

City/State/Zip: Provo, UT 84601

Date: January 18, 1994

GENERAL INFORMATION**Site Description and Operational History:**

REFER TO PART I IN GENERAL SITE INFORMATION

Probable Substances of Concern:
(Previous investigations, analytical data)

REFER TO PART IV AND APPENDICIES A THROUGH-D

GENERAL INFORMATION (continued)

Site Sketch:

(Show all pertinent features, indicate sources and closest targets, indicate north)

REFER TO PART I GENERAL SITE INFORMATION

SOURCE EVALUATION

Source No.: 01	Source Name: PACIFIC MINE	Source Waste Quantity (WQ) Calculations:
Source Description: Source consists of tailings pile, two contaminated ground water discharge and spoil piles.		120,000 square feet total X average depth of tailings of 5 feet = 600,000 cubic feet of waste.

Source No.: 02	Source Name: MARY ELLEN GULCH	Source Waste Quantity (WQ) Calculations:
Source Description: Tailing and waste rock piles; spoils dump, and contaminated ground water discharge		

Source No.: 03	Source Name: LOWER BOG	Source Waste Quantity (WQ) Calculations: 6900
Source Description: Tailings pile, miscellaneous spoils piles, and contaminated ground water discharge		
		Site WC: 100

PA TABLE 1: WASTE CHARACTERISTICS (WC) SCORES

PA Table 1a: WC Scores for Single Source Sites and Formulas for Multiple Source Sites

TIER	SOURCE TYPE	SINGLE SOURCE SITES (assigned WC scores)			MULTIPLE SOURCE SITES Formula for Assigning Source WQ Values
		WC = 18	WC = 32	WC = 100	
UGROUND SURFACE	N/A	≤ 100 lb	> 100 to 10,000 lb	$> 10,000$ lb	$lb + 1$
WATER-BODIED	N/A	$\leq 500,000$ lb	$> 500,000$ to 50 million lb	> 50 million lb	$lb + 5,000$
VOLUME	Landfill	≤ 6.75 million ft^3 $\leq 250,000$ yd^3	> 6.75 million to 675 million ft^3 $> 250,000$ to 25 million yd^3	> 675 million ft^3 > 25 million yd^3	$ft^3 + 67,500$ $yd^3 + 2,500$
	Surface impoundment	$\leq 6,750$ ft^3 ≤ 250 yd^3	$> 6,750$ to 675,000 ft^3 > 250 to 25,000 yd^3	$> 675,000$ ft^3 $> 25,000$ yd^3	$ft^3 + 67.5$ $yd^3 + 2.5$
	Drums	$\leq 1,000$ drums	$> 1,000$ to 100,000 drums	$> 100,000$ drums	$drums + 10$
	Tanks and non-drum containers	$\leq 50,000$ gallons	$> 50,000$ to 5 million gallons	> 5 million gallons	$gallons + 500$
	Contaminated soil	≤ 6.75 million ft^3 $\leq 250,000$ yd^3	> 6.75 million to 675 million ft^3 $> 250,000$ to 25 million yd^3	> 675 million ft^3 > 25 million yd^3	$ft^3 + 67,500$ $yd^3 + 2,500$
	Pile	$\leq 6,750$ ft^3 ≤ 250 yd^3	$> 6,750$ to 675,000 ft^3 > 250 to 25,000 yd^3	$> 675,000$ ft^3 $> 25,000$ yd^3	$ft^3 + 67.5$ $yd^3 + 2.5$
AREA	Other	$\leq 6,750$ ft^3 ≤ 250 yd^3	$> 6,750$ to 675,000 ft^3 > 250 to 25,000 yd^3	$> 675,000$ ft^3 $> 25,000$ yd^3	$ft^3 + 67.5$ $yd^3 + 2.5$
	Landfill	$\leq 340,000$ ft^3 ≤ 7.8 acres	$> 340,000$ to 34 million ft^3 > 7.8 to 780 acres	> 34 million ft^3 > 780 acres	$ft^3 + 3,400$ $acres + 0.078$
	Surface impoundment	$\leq 1,300$ ft^3 ≤ 0.029 acres	$> 1,300$ to 130,000 ft^3 > 0.029 to 2.9 acres	$> 130,000$ ft^3 > 2.9 acres	$ft^3 + 13$ $acres + 0.00029$
	Contaminated soil	≤ 3.4 million ft^3 ≤ 78 acres	> 3.4 million to 340 million ft^3 > 78 to 7,800 acres	> 340 million ft^3 $> 7,800$ acres	$ft^3 + 34,000$ $acres + 0.78$
	Pile*	$\leq 1,300$ ft^3 ≤ 0.029 acres	$> 1,300$ to 130,000 ft^3 > 0.029 to 2.9 acres	$> 130,000$ ft^3 > 2.9 acres	$ft^3 + 13$ $acres + 0.00029$
	Land treatment	$\leq 27,000$ ft^3 ≤ 0.62 acres	$> 27,000$ to 2.7 million ft^3 > 0.62 to 62 acres	> 2.7 million ft^3 > 62 acres	$ft^3 + 270$ $acres + 0.0062$

1 ton = 2,000 lb = 1 yd^3 = 4 drums = 200 gallons.

* Use area of land surface under pile, not surface area of pile.

PA Table 1b: WC Scores for Multiple Source Sites

WQ Total	WC Score
> 0 to 100	18
> 100 to 10,000	32
$> 10,000$	100

**GROUND WATER PATHWAY
GROUND WATER USE DESCRIPTION**

Describe Ground Water Use Within 4-miles of the Site:
(Describe stratigraphy, information on aquifers, municipal and/or private wells)

See Groundwater section in narrative

Calculations for Drinking Water Populations Served by Ground Water:

GROUND WATER PATHWAY CRITERIA LIST	
SUSPECTED RELEASE	PRIMARY TARGETS
<p>Y N U e o n - s k</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Are sources poorly contained?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is the source a type likely to contribute to ground water contamination (e.g., wet lagoon)?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> Is waste quantity particularly large?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is precipitation heavy?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is the infiltration rate high?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is the site located in an area of karst terrain?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> Is the subsurface highly permeable or conductive?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is drinking water drawn from a shallow aquifer?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> Are suspected contaminants highly mobile in ground water?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Does analytical or circumstantial evidence suggest ground water contamination?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Other criteria? _____</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> SUSPECTED RELEASE?</p>	<p>Y N U e o n - s k</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is any drinking water well nearby?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Has any nearby drinking water well been closed?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Has any nearby drinking water user reported foul-tasting or foul-smelling water?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Does any nearby well have a large drawdown or high production rate?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is any drinking water well located between the site and other wells that are suspected to be exposed to a hazardous substance?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Does analytical or circumstantial evidence suggest contamination at a drinking water well?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Does any drinking water well warrant sampling?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Other criteria? _____</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> PRIMARY TARGET(S) IDENTIFIED?</p>
<p>Summarize the rationale for Suspected Release (attach an additional page if necessary):</p>	<p>Summarize the rationale for Primary Targets (attach an additional page if necessary):</p>

GROUND WATER PATHWAY SCORESHEET

Pathway Characteristics	
Do you suspect a release (see Ground Water Pathway Criteria List, page 7)?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Is the site located in karst terrain?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Depth to aquifer:	<input type="text"/> ft
Distance to the nearest drinking water well:	<input type="text"/> ft

LIKELIHOOD OF RELEASE

1. SUSPECTED RELEASE: If you suspect a release to ground water (see page 7), assign a score of 550. Use only column A for this pathway.
2. NO SUSPECTED RELEASE: If you do not suspect a release to ground water, and the site is in karst terrain or the depth to aquifer is 70 feet or less, assign a score of 500; otherwise, assign a score of 340. Use only column B for this pathway.

	A Suspected Release	B No Suspected Release	Reference
	550	500 or 340	
LR =		340	

TARGETS

3. PRIMARY TARGET POPULATION: Determine the number of people served by drinking water wells that you suspect have been exposed to a hazardous substance from the site (see Ground Water Pathway Criteria List, page 7).
 people $\times 10 =$
4. SECONDARY TARGET POPULATION: Determine the number of people served by drinking water wells that you do NOT suspect have been exposed to a hazardous substance from the site, and assign the total population score from PA Table 2.
 Are any wells part of a blended system? Yes ☐ No ☒
 If yes, attach a page to show apportionment calculations.
5. NEAREST WELL: If you have identified a primary target population for ground water, assign a score of 50; otherwise, assign the Nearest Well score from PA Table 2. If no drinking water wells exist within 4 miles, assign a score of zero.
6. WELLHEAD PROTECTION AREA (WHPA): If any source lies within or above a WHPA, or if you have identified any primary target well within a WHPA, assign a score of 20; assign 5 if neither condition holds but a WHPA is present within 4 miles; otherwise assign zero.
7. RESOURCES

	0		
	0	0	
	0	0	
	0	0	
	0	0	
	5	5	
T =		5	

WASTE CHARACTERISTICS

8. A. If you have identified any primary target for ground water, assign the waste characteristics score calculated on page 4, or a score of 32, whichever is GREATER; do not evaluate part B of this factor.
- B. If you have NOT identified any primary target for ground water, assign the waste characteristics score calculated on page 4.

	100 or 32	
	100, 32, or 10	100, 32, or 10
WC =		445

GROUND WATER PATHWAY SCORE:

$$\frac{LR \times T \times WC}{82,500}$$

(subject to a maximum of 100)

2.6

PA TABLE 2: VALUES FOR SECONDARY GROUND WATER TARGET POPULATIONS

PA Table 2a: Non-Karst Aquifers

Distance from Site	Population	Nearest Well (choose highest)	Population Served by Wells Within Distance Category										Population Value
			1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	Greater than 100,000	
0 to ¼ mile	0	20	1	2	5	16	52	163	521	1,633	5,214	16,325	1
> ¼ to ½ mile	0	18	1	1	3	10	32	101	323	1,012	3,233	10,121	
> ½ to 1 mile	0	9	1	1	2	5	17	52	167	522	1,668	5,224	
> 1 to 2 miles	0	5	1	1	1	3	9	29	94	294	939	2,938	
> 2 to 3 miles	0	3	1	1	1	2	7	21	68	212	678	2,122	
> 3 to 4 miles	0	2	1	1	1	1	4	13	42	131	417	1,306	1
Nearest Well =		2	Score =										1

PA Table 2b: Karst Aquifers

Distance from Site	Population	Nearest Well (use 20 for karst)	Population Served by Wells Within Distance Category										Population Value
			1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	Greater than 100,000	
0 to ¼ mile	0	20	1	2	5	16	52	163	521	1,633	5,214	16,325	
> ¼ to ½ mile	0	20	1	1	3	10	32	101	323	1,012	3,233	10,121	
> ½ to 1 mile	0	20	1	1	3	8	26	82	261	816	2,607	8,162	
> 1 to 2 miles	0	20	1	1	3	8	26	82	261	816	2,607	8,162	
> 2 to 3 miles	0	20	1	1	3	8	26	82	261	816	2,607	8,162	
> 3 to 4 miles	0	20	1	1	3	8	26	82	261	816	2,607	8,162	
Nearest Well =			Score =										

**SURFACE WATER PATHWAY
MIGRATION ROUTE SKETCH**

Surface Water Migration Route Sketch:

(include runoff route, probable point of entry, 15-mile target distance limit, intakes, fisheries, and sensitive environments)

SURFACE WATER PATHWAY CRITERIA LIST	
SUSPECTED RELEASE	PRIMARY TARGETS
<p>Y N U e o n s k</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is surface water nearby?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is waste quantity particularly large?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is the drainage area large?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is rainfall heavy?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is the infiltration rate low?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Are sources poorly contained or prone to runoff or flooding?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is a runoff route well defined (e.g., ditch or channel leading to surface water)?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> Is vegetation stressed along the probable runoff route?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Are sediments or water unnaturally discolored?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is wildlife unnaturally absent?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Has deposition of waste into surface water been observed?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is ground water discharge to surface water likely?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Does analytical or circumstantial evidence suggest surface water contamination?</p> <p><input type="checkbox"/> <input type="checkbox"/> Other criteria? _____</p> <p><input type="checkbox"/> <input type="checkbox"/> SUSPECTED RELEASE?</p>	<p>Y N U e o n s k</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Is any target nearby? If yes:</p> <p><input type="checkbox"/> Drinking water intake</p> <p><input checked="" type="checkbox"/> Fishery</p> <p><input checked="" type="checkbox"/> Sensitive environment</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Has any intake, fishery, or recreational area been closed?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Does analytical or circumstantial evidence suggest surface water contamination at or downstream of a target?</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Does any target warrant sampling? If yes:</p> <p><input type="checkbox"/> Drinking water intake</p> <p><input type="checkbox"/> Fishery</p> <p><input type="checkbox"/> Sensitive environment</p> <p><input type="checkbox"/> <input type="checkbox"/> Other criteria? _____</p> <p><input type="checkbox"/> <input type="checkbox"/> PRIMARY INTAKE(S) IDENTIFIED?</p> <p><input type="checkbox"/> <input type="checkbox"/> PRIMARY FISHERY(IES) IDENTIFIED?</p> <p><input type="checkbox"/> <input type="checkbox"/> PRIMARY SENSITIVE ENVIRONMENT(S) IDENTIFIED?</p>
<p>Summarize the rationale for Suspected Release (attach an additional page if necessary):</p>	<p>Summarize the rationale for Primary Targets (attach an additional page if necessary):</p>

SURFACE WATER PATHWAY LIKELIHOOD OF RELEASE AND DRINKING WATER THREAT SCORESHEET

Pathway Characteristics	
Do you suspect a release (see Surface Water Pathway Criteria List, page 11)?	Yes <u>X</u> No <u> </u>
Distance to surface water:	<u>10</u> ft
Flood frequency:	<u> </u> yrs
What is the downstream distance to the nearest drinking water intake?	<u>20</u> miles
Nearest fishery?	<u>.0001</u> miles
Nearest sensitive environment?	<u>.0001</u> miles

LIKELIHOOD OF RELEASE

- SUSPECTED RELEASE:** If you suspect a release to surface water (see page 11), assign a score of 550. Use only column A for this pathway.
- NO SUSPECTED RELEASE:** If you do not suspect a release to surface water, use the table below to assign a score based on distance to surface water and flood frequency. Use only column B for this pathway.

Distance to surface water \leq 2,500 feet	500
Distance to surface water > 2,500 feet, and	
Site in annual or 10-year floodplain	500
Site in 100-year floodplain	400
Site in 500-year floodplain	300
Site outside 500-year floodplain	100

A	B	Reference
Suspected Release	No Suspected Release	
550 <small>(500)</small>	 <small>(500, 400, 300 or 100)</small>	
550 <small>(500)</small>	 <small>(500, 400, 300 or 100)</small>	

LR =

DRINKING WATER THREAT TARGETS

- Record the water body type, flow (if applicable), and number of people served by each drinking water intake within the target distance limit. If there is no drinking water intake within the target distance limit, factors 4, 5, and 6 each receive zero scores.

Intake Name	Water Body Type	Flow	People Served
_____	_____	cfs _____	
_____	_____	cfs _____	
_____	_____	cfs _____	

- PRIMARY TARGET POPULATION:** If you suspect any drinking water intake listed above has been exposed to a hazardous substance from the site (see Surface Water Pathway Criteria List, page 11), list the intake name(s) and calculate the factor score based on the total population served.

0 people \times 10 = 0

- SECONDARY TARGET POPULATION:** Determine the number of people served by drinking water intakes that you do NOT suspect have been exposed to a hazardous substance from the site, and assign the total population score from PA Table 3.

Are any intakes part of a blended system? Yes No
If yes, attach a page to show apportionment calculations.

- NEAREST INTAKE:** If you have identified a primary target population for the drinking water threat (factor 4), assign a score of 50; otherwise, assign the Nearest Intake score from PA Table 3. If no drinking water intake exists within the target distance limit, assign a score of zero.

- RESOURCES**

T =

0 <small>(50, 20, 10, 5, 1, or 0)</small>	 <small>(50, 10, 5, 1, or 0)</small>
50 <small>(5 or 0)</small>	 <small>(5 or 0)</small>
5 <small>(5 or 0)</small>	 <small>(5 or 0)</small>
55	

PA TABLE 3: VALUES FOR SECONDARY SURFACE WATER TARGET POPULATIONS

Surface Water Body Flow (see PA Table 4)	Population	Nearest Intake (choose highest)	Population Served by Intakes Within Flow Category											Population Value
			1 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	Greater than 1,000,000	
< 10 cfs	_____	20	2	5	16	52	163	521	1,633	5,214	16,325	52,136	163,246	_____
10 to 100 cfs	<u>0</u>	2	1	1	2	5	16	52	163	521	1,633	5,214	16,325	<u>1</u>
> 100 to 1,000 cfs	_____	1	0	0	1	1	2	5	16	52	163	521	1,633	_____
> 1,000 to 10,000 cfs	_____	0	0	0	0	0	1	1	2	5	16	52	163	_____
> 10,000 cfs or Great Lakes	_____	0	0	0	0	0	0	0	1	1	2	5	16	_____
3-mile Mixing Zone	_____	10	1	3	8	26	82	261	816	2,607	8,162	26,068	81,653	_____
Nearest Intake =		<u>2</u>												Score = <u>.1</u>

A-25

PA TABLE 4: SURFACE WATER TYPE / FLOW CHARACTERISTICS WITH DILUTION WEIGHTS FOR SECONDARY SURFACE WATER SENSITIVE ENVIRONMENTS

Type of Surface Water Body		Dilution Weight
Water Body Type	OR Flow	
minimal stream	< 10 cfs	1
small to moderate stream	10 to 100 cfs	0.1
moderate to large stream	> 100 to 1,000 cfs	N/A
large stream to river	> 1,000 to 10,000 cfs	N/A
large river	> 10,000 cfs	N/A
3-mile mixing zone of quiet flowing streams or rivers	10 cfs or greater	N/A
coastal tidal water (harbors, sounds, bays, etc.), ocean, or Great Lakes	N/A	N/A

SURFACE WATER PATHWAY (continued)
HUMAN FOOD CHAIN THREAT SCORESHEET

LIKELIHOOD OF RELEASE	A		B		References
	Suspected Release	No Suspected Release	Suspected Release	No Suspected Release	
Enter Surface Water Likelihood of Release score from page 12.	LR = 550				

HUMAN FOOD CHAIN THREAT TARGETS

8. Record the water body type and flow (if applicable) for each fishery within the target distance limit. If there is no fishery within the target distance limit, assign a Targets score of 0 at the bottom of the page.

Fishery Name	Water Body Type	Flow
North Fork of AF River	River	* 6.7 cfs
		cfs
		cfs
		cfs
		cfs

9. PRIMARY FISHERIES: If you suspect any fishery listed above has been exposed to a hazardous substance from the site (see Surface Water Criteria List, page 11), assign a score of 300 and do not evaluate Factor 10. List the primary fisheries:
- AF River

10. SECONDARY FISHERIES

- A. If you suspect a release to surface water and have identified a secondary fishery but no primary fishery, assign a score of 210.
- B. If you do not suspect a release, assign a Secondary Fisheries score from the table below using the lowest flow at any fishery within the target distance limit.

Lowest Flow	Secondary Fisheries Score
< 10 cfs	210
10 to 100 cfs	30
> 100 cfs, coastal tidal waters, oceans, or Great Lakes	12

* Ave Low Flow Aug 1

T =

1300	
300	
1210	
1210.30 = 12	
210.210 = 0	1210.30.12 = 0

**SURFACE WATER PATHWAY (continued)
ENVIRONMENTAL THREAT SCORESHEET**

LIKELIHOOD OF RELEASE

Enter Surface Water Likelihood of Release score from page 12.

LR =

A	B
<i>Suspected Release</i>	<i>No Suspected Release</i>
1000	1000, 500, 200 or 100
550	

*References***ENVIRONMENTAL THREAT TARGETS**

11. Record the water body type and flow (if applicable) for each surface water sensitive environment within the target distance limit (see PA Tables 4 and 5). If there is no sensitive environment within the target distance limit, assign a Targets score of 0 at the bottom of the page.

<i>Environment Name</i>	<i>Water Body Type</i>	<i>Flow</i>
		cfs
		cfs
		cfs
		cfs
		cfs

12. PRIMARY SENSITIVE ENVIRONMENTS: If you suspect any sensitive environment listed above has been exposed to a hazardous substance from the site (see Surface Water Criteria List, page 11), assign a score of 300 and do not evaluate factor 13. List the primary sensitive environments:
- _____
- _____

13. SECONDARY SENSITIVE ENVIRONMENTS: If sensitive environments are present, but none is a primary sensitive environment, evaluate Secondary Sensitive Environments based on flow.

- A. For secondary sensitive environments on surface water bodies with flows of 100 cfs or less, assign scores as follows, and do not evaluate part B of this factor:

<i>Flow</i>	<i>Dilution Weight</i> (PA Table 4)	<i>Environment Type and Value</i> (PA Tables 5 and 6)	<i>Total</i>
cfs	.01	x 400	= 4
cfs		x	=
cfs		x	=
cfs		x	=
cfs		x	=

Sum =

- B. If all secondary sensitive environments are located on surface water bodies with flows > 100 cfs, assign a score of 10.

T =

300	
4	
100	100
304	

PA TABLE 5: SURFACE WATER AND AIR PATHWAY SENSITIVE ENVIRONMENTS VALUES

<i>Sensitive Environment</i>	<i>Assigned Value</i>
Critical habitat for Federally designated endangered or threatened species	100
Marine Sanctuary	
National Park	
Designated Federal Wilderness Area	
Ecologically important areas identified under the Coastal Zone Wilderness Act	
Sensitive Areas identified under the National Estuary Program or Near Coastal Water Program of the Clean Water Act	
Critical Areas identified under the Clean Lakes Program of the Clean Water Act (subareas in lakes or entire small lakes)	
National Monument (air pathway only)	
National Seashore Recreation Area	
National Lakeshore Recreation Area	
Habitat known to be used by Federally designated or proposed endangered or threatened species	75
National Preserve	
National or State Wildlife Refuge	
Unit of Coastal Barrier Resources System	
Federal land designated for the protection of natural ecosystems	
Administratively Proposed Federal Wilderness Area	
Spawning areas critical for the maintenance of fish/shellfish species within a river system, bay, or estuary	
Migratory pathways and feeding areas critical for the maintenance of anadromous fish species in a river system	
Terrestrial areas utilized for breeding by large or dense aggregations of vertebrate animals (air pathway) or semi-aquatic foragers (surface water pathway)	
National river reach designated as Recreational	
Habitat known to be used by State designated endangered or threatened species	50
Habitat known to be used by a species under review as to its Federal endangered or threatened status	
Coastal Barrier (partially developed)	
Federally designated Scenic or Wild River	
State land designated for wildlife or game management	25
State designated Scenic or Wild River	
State designated Natural Area	
Particular areas, relatively small in size, important to maintenance of unique biotic communities	
State designated areas for protection/maintenance of aquatic life under the Clean Water Act	5
Wetlands	See PA Table 6 (Surface Water Pathway) or PA Table 9 (Air Pathway)

PA TABLE 6: SURFACE WATER PATHWAY
WETLANDS FRONTAGE VALUES

<i>Total Length of Wetlands</i>	<i>Assigned Value</i>
Less than 0.1 mile	0
0.1 to 1 mile	25
Greater than 1 to 2 miles	50
Greater than 2 to 3 miles	75
Greater than 3 to 4 miles	100
Greater than 4 to 8 miles	150
Greater than 8 to 12 miles	250
Greater than 12 to 16 miles	350
Greater than 16 to 20 miles	450
Greater than 20 miles	500

**SURFACE WATER PATHWAY (concluded)
WASTE CHARACTERISTICS, THREAT, AND PATHWAY SCORE SUMMARY**

WASTE CHARACTERISTICS	A <i>Suspected Release</i>	B <i>No Suspected Release</i>
14. A. If you have identified any primary target for surface water (pages 12, 14, or 15), assign the waste characteristics score calculated on page 4, or a score of 32, whichever is GREATER; do not evaluate part B of this factor.	(100 or 32) 100	
B. If you have NOT identified any primary target for surface water, assign the waste characteristics score calculated on page 4.	(100, 32, or 10)	(100, 32, or 10)
WC =	100	

SURFACE WATER PATHWAY THREAT SCORES

Threat	<i>Likelihood of Release (LR) Score (from page 12)</i>	<i>Targets (T) Score (pages 12, 14, 15)</i>	<i>Pathway Waste Characteristics (WC) Score (determined above)</i>	<i>Threat Score LR x T x WC / 82,500</i>
Drinking Water	550	55	100	37 <small>(subject to a maximum of 100)</small>
Human Food Chain	550	300	100	100 <small>(subject to a maximum of 100)</small>
Environmental	550	304	100	203 <small>(subject to a maximum of 100)</small>

SURFACE WATER PATHWAY SCORE
(Drinking Water Threat + Human Food Chain Threat + Environmental Threat)

<small>(subject to a maximum of 100)</small> 100

SOIL EXPOSURE PATHWAY CRITERIA LIST	
SUSPECTED CONTAMINATION	RESIDENT POPULATION
Surficial contamination can generally be assumed.	<p>Y N U e o n s k</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is any residence, school, or daycare facility on or within 200 feet of an area of suspected contamination?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is any residence, school, or daycare facility located on adjacent land previously owned or leased by the site owner/operator?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Is there a migration route that might spread hazardous substances near residences, schools, or daycare facilities?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Have onsite or adjacent residents or students reported adverse health effects, exclusive of apparent drinking water or air contamination problems?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Does any neighboring property warrant sampling?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> Other criteria? _____</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> RESIDENT POPULATION IDENTIFIED?</p>
Summarize the rationale for Resident Population (attach an additional page if necessary):	

SOIL EXPOSURE PATHWAY SCORESHEET

Pathway Characteristics	
Do any people live on or within 200 ft of areas of suspected contamination?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Do any people attend school or daycare on or within 200 ft of areas of suspected contamination?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Is the facility active? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, estimate the number of workers: _____	

LIKELIHOOD OF EXPOSURE

1. SUSPECTED CONTAMINATION: Surficial contamination can generally be assumed, and a score of 550 assigned. Assign zero only if the absence of surficial contamination can be confidently demonstrated.

LE =

Suspected
Contamination
(550 or 0)

550

References

RESIDENT POPULATION THREAT TARGETS

2. RESIDENT POPULATION: Determine the number of people occupying residences or attending school or daycare on or within 200 feet of areas of suspected contamination (see Soil Exposure Pathway Criteria List, page 18).

_____ people x 10 =

0

3. RESIDENT INDIVIDUAL: If you have identified a resident population (factor 2), assign a score of 50; otherwise, assign a score of 0.

0

4. WORKERS: Use the following table to assign a score based on the total number of workers at the facility and nearby facilities with suspected contamination:

Number of Workers	Score
0	0
1 to 100	5
101 to 1,000	10
> 1,000	15

0

5. TERRESTRIAL SENSITIVE ENVIRONMENTS: Use PA Table 7 to assign a value for each terrestrial sensitive environment on an area of suspected contamination:

Terrestrial Sensitive Environment Type	Value
_____	_____
_____	_____

Sum =

25

6. RESOURCES

5

T =

30

WASTE CHARACTERISTICS

7. Assign the waste characteristics score calculated on page 4.

WC =

(100, 25, or 10)
100

RESIDENT POPULATION THREAT SCORE:

$$\frac{LE \times T \times WC}{82,500}$$

Subject to a maximum of 100

20

NEARBY POPULATION THREAT SCORE:

1

1, 2, or 11

SOIL EXPOSURE PATHWAY SCORE:

Resident Population Threat + Nearby Population Threat

Subject to a maximum of 100

21

PA TABLE 7: SOIL EXPOSURE PATHWAY
TERRESTRIAL SENSITIVE ENVIRONMENT VALUES

<i>Terrestrial Sensitive Environment</i>	<i>Assigned Value</i>
Terrestrial critical habitat for Federally designated endangered or threatened species	100
National Park	
Designated Federal Wilderness Area	
National Monument	
Terrestrial habitat known to be used by Federally designated or proposed threatened or endangered species	75
National Preserve (terrestrial)	
National or State terrestrial Wildlife Refuge	
Federal land designated for protection of natural ecosystems	
Administratively proposed Federal Wilderness Area	
Terrestrial areas utilized by large or dense aggregations of animals (vertebrate species) for breeding	
Terrestrial habitat used by State designated endangered or threatened species	50
Terrestrial habitat used by species under review for Federal designated endangered or threatened status	
State lands designated for wildlife or game management	25
State designated Natural Areas	
Particular areas, relatively small in size, important to maintenance of unique biotic communities	

AIR PATHWAY CRITERIA LIST	
SUSPECTED RELEASE	PRIMARY TARGETS
<p>Y N U e o n - s k</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Are odors currently reported?</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Has release of a hazardous substance to the air been directly observed?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Are there reports of adverse health effects (e.g., headaches, nausea, dizziness) potentially resulting from migration of hazardous substances through the air?</p> <p><input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> Does analytical or circumstantial evidence suggest a release to the air?</p> <p><input type="checkbox"/> <input type="checkbox"/> Other criteria? _____</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/> SUSPECTED RELEASE?</p>	<p>If you suspect a release to air, evaluate all populations and sensitive environments within 1/4 mile (including those onsite) as primary targets.</p>
<p>Summarize the rationale for Suspected Release (attach an additional page if necessary):</p> <p>Release to the air pathway occurs during periods of wind at all three sites. Dust from tailings will travel through means of the air pathway.</p>	

AIR PATHWAY SCORESHEET

Pathway Characteristics	
Do you suspect a release (see Air Pathway Criteria List, page 21)?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Distance to the nearest individual:	_____ ft

LIKELIHOOD OF RELEASE

1. SUSPECTED RELEASE: If you suspect a release to air (see page 21), assign a score of 550. Use only column A for this pathway.
2. NO SUSPECTED RELEASE: If you do not suspect a release to air, assign a score of 500. Use only column B for this pathway.

	A	B	Reference
	Suspected Release (1400)	No Suspected Release (500)	
1. SUSPECTED RELEASE: If you suspect a release to air (see page 21), assign a score of 550. Use only column A for this pathway.	550		
2. NO SUSPECTED RELEASE: If you do not suspect a release to air, assign a score of 500. Use only column B for this pathway.			
LR =	550		

TARGETS

3. PRIMARY TARGET POPULATION: Determine the number of people subject to exposure from a suspected release of hazardous substances to the air.
_____ people $\times 10 =$
4. SECONDARY TARGET POPULATION: Determine the number of people not suspected to be exposed to a release to air, and assign the total population score using PA Table 8.
5. NEAREST INDIVIDUAL: If you have identified any Primary Target Population for the air pathway, assign a score of 50; otherwise, assign the Nearest Individual score from PA Table 8.
6. PRIMARY SENSITIVE ENVIRONMENTS: Sum the sensitive environment values (PA Table 5) and wetland acreage values (PA Table 9) for environments subject to exposure from a suspected release to the air.

Sensitive Environment Type	Value
Wetland	

Sum =

7. SECONDARY SENSITIVE ENVIRONMENTS: Use PA Table 10 to determine the score for secondary sensitive environments.
8. RESOURCES

	A	B	Reference
	0		
3. PRIMARY TARGET POPULATION: Determine the number of people subject to exposure from a suspected release of hazardous substances to the air. _____ people $\times 10 =$	0		
4. SECONDARY TARGET POPULATION: Determine the number of people not suspected to be exposed to a release to air, and assign the total population score using PA Table 8.			
5. NEAREST INDIVIDUAL: If you have identified any Primary Target Population for the air pathway, assign a score of 50; otherwise, assign the Nearest Individual score from PA Table 8.	20		
6. PRIMARY SENSITIVE ENVIRONMENTS: Sum the sensitive environment values (PA Table 5) and wetland acreage values (PA Table 9) for environments subject to exposure from a suspected release to the air.	0		
Sum =			
7. SECONDARY SENSITIVE ENVIRONMENTS: Use PA Table 10 to determine the score for secondary sensitive environments.			
8. RESOURCES	5		
T =	25		

WASTE CHARACTERISTICS

9. A. If you have identified any Primary Target for the air pathway, assign the waste characteristics score calculated on page 4, or a score of 32, whichever is GREATER; do not evaluate part B of this factor.
- B. If you have NOT identified any Primary Target for the air pathway, assign the waste characteristics score calculated on page 4.

WC =

AIR PATHWAY SCORE:

$$\frac{LR \times T \times WC}{82,500}$$

Indicated by a maximum of 1400
17

PA TABLE 8: VALUES FOR SECONDARY AIR TARGET POPULATIONS

Distance from Site	Population	Nearest Individual (choose highest)	Population Within Distance Category													Population Value
			1	11	31	101	301	1,001	3,001	10,001	30,001	100,001	300,001	Greater than		
			to 10	to 30	to 100	to 300	to 1,000	to 3,000	to 10,000	to 30,000	to 100,000	to 300,000	to 1,000,000	1,000,000		
Onsite	_____	20	1	2	5	10	52	163	521	1,633	5,214	16,325	52,136	163,246	_____	
>0 to ¼ mile	_____	20	1	1	1	4	13	41	130	408	1,303	4,081	13,034	40,811	_____	
> ¼ to ½ mile	_____	2	0	0	1	1	3	9	28	88	282	882	2,815	8,815	_____	
> ½ to 1 mile	_____	1	0	0	0	1	1	3	8	26	83	261	834	2,612	_____	
> 1 to 2 miles	_____	0	0	0	0	0	1	1	3	8	27	83	266	833	_____	
> 2 to 3 miles	_____	0	0	0	0	0	1	1	1	4	12	38	120	376	_____	
> 3 to 4 miles	_____	0	0	0	0	0	0	1	1	2	7	23	73	229	_____	
Nearest Individual = _____			Score = _____													

A-45

PA TABLE 9: AIR PATHWAY VALUES FOR WETLAND AREA

Wetland Area	Assigned Value
Less than 1 acre	0
1 to 50 acres	25
Greater than 50 to 100 acres	75
Greater than 100 to 150 acres	125
Greater than 150 to 200 acres	175
Greater than 200 to 300 acres	250
Greater than 300 to 400 acres	350
Greater than 400 to 500 acres	450
Greater than 500 acres	500

PA TABLE 10: DISTANCE WEIGHTS AND CALCULATIONS FOR AIR PATHWAY SECONDARY SENSITIVE ENVIRONMENTS

	Distance	Sensitive Environment Type and Value (from PA Table 5 or 9)		Product
Distance	Weight			
Onsite	0.10	x		
		x		
0-1/4 mi	0.025	x		
		x		
1/4-1/2mi	0.0054	x		
		x		
		x		
Total Environments Score =				

SITE SCORE CALCULATION

	S	S ²
GROUND WATER PATHWAY SCORE (S _{gw}):	2.06	4.24
SURFACE WATER PATHWAY SCORE (S _{sw}):	100	10,000
SOIL EXPOSURE PATHWAY SCORE (S _s):	21	441
AIR PATHWAY SCORE (S _a):	17	289
SITE SCORE:	$\sqrt{\frac{S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2}{4}}$	51.8

SUMMARY

	YES	NO
1. Is there a high possibility of a threat to any nearby drinking water well(s) by migration of a hazardous substance in ground water?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A. If yes, identify the well(s). _____		
B. If yes, how many people are served by the threatened well(s)? _____		
2. Is there a high possibility of a threat to any of the following by hazardous substance migration in surface water?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A. Drinking water intake	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
B. Fishery	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C. Sensitive environment (wetland, critical habitat, others)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
D. If yes, identify the target(s). _____		
3. Is there a high possibility of an area of surficial contamination within 200 feet of any residence, school, or daycare facility?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, identify the property(ies) and estimate the associated population(s). _____		
4. Are there public health concerns at this site that are not addressed by PA scoring considerations? If yes, explain:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Campers _____		

PART III

Correspondence
(in cronological order)



United States
Department of
Agriculture

Forest
Service

R-4

To: 2840 Reclamation

Date: AUG 7 1985

Subject: Functional Assistance - Pacific Mine

To: Forest Supervisor, Uinta NF

Enclosed is a short summary and photograph report from Ben Albrechtsen's recent trip to the Uinta National Forest. We hope you find these comments helpful. Please transmit the original to Harry Opfar for his field use.

If you have comments or questions, please contact Ben directly.

E. R. Browning
E. R. BROWNING
Director
Minerals Area Management

Enclosure

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2840

Reclamation Recommendations
for
Pacific Mine
Pleasant Grove Ranger District
Uinta National Forest

by
Ben Albrechtsen
R-4 Reclamation Specialist
July 1985

Summary

On July 22, I spent the day on the Pleasant Grove Ranger District reviewing the Pacific Mine property. The purpose of my trip was to make suggestions for reclamation of this area. Accompanying me were:

Harry Ophar - Ranger
Ralph McDonald - Forestry Technician

The Pacific Mine is an old gold and silver mine that is still held by active claims. The present claimant is Dan Proctor of Pleasant Grove, Utah. Mr. Proctor is interested in spending several thousand dollars in the near future to drill the property, define the ore body, and reopen the mine. Additionally, he has verbally agreed to provide some reclamation on the previously disturbed site and old tailings pond.

The mine is located in the upper reaches of American Fork Canyon approximately 10 miles above Timpanogus Cave National Monument. American Fork River heads above the mine and is being polluted from water coming off the mine dump and out of the old portal. Recent high water and current beaver activity are worsening this situation, causing further pollution to downstream recreation, irrigation, and fisheries values.

I feel every effort should be made to correct this situation as soon as possible. If the Ranger can negotiate some reclamation through an operating plan, that would be excellent. If this cannot be accomplished quickly, then the Utah State Department of Water Resources should review the situation and corrective action be taken. Part of the property is on private land and the Ranger should get the Utah Division of Oil, Gas and Mining to review the problem. It appears this property would be high on their list for reclamation action.

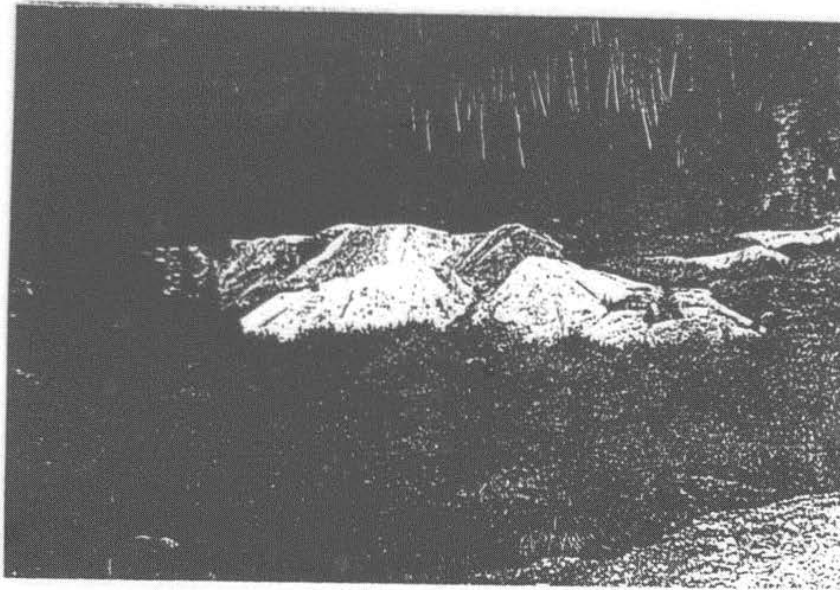
The following are immediate remedial actions that need to be taken at the Pacific Mine:

1. Divert the portal drainage away from the tailings area and into its original channel and then to the main American Fork Creek.
2. Obtain both water and soil samples to see if acid mine drainage exists and what contaminants are in the tailings. Send the soil to A&L Laboratory in Omaha, Nebraska. Mention that samples are mine spoils and a complete analysis is needed.
3. Close the mine area to off-road vehicle travel to reduce disturbance to the site. This will reduce sediment into the stream until reclamation can be accomplished.
4. If suspected acid contaminants are present, call for reclamation assistance from the Intermountain Station in Logan.

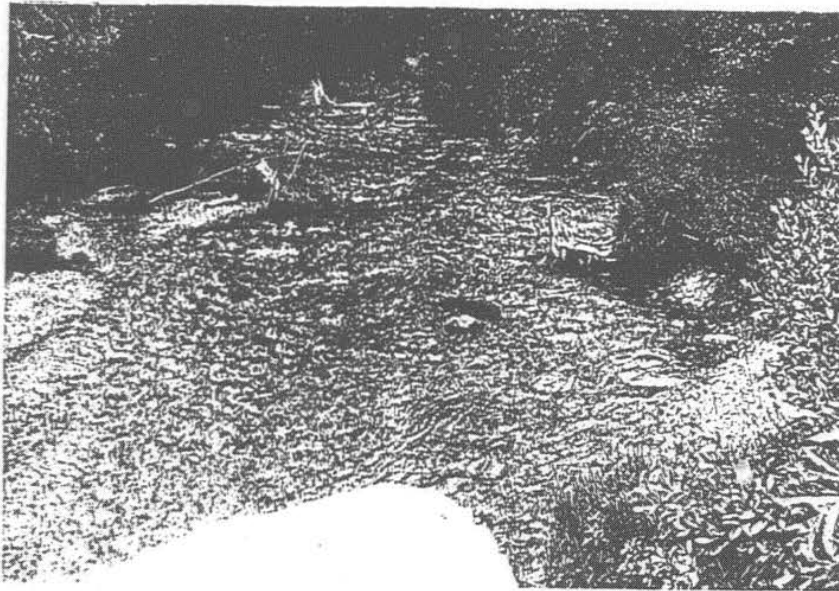
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Ben Albrechtsen
Ben Albrechtsen
Reclamation Specialist



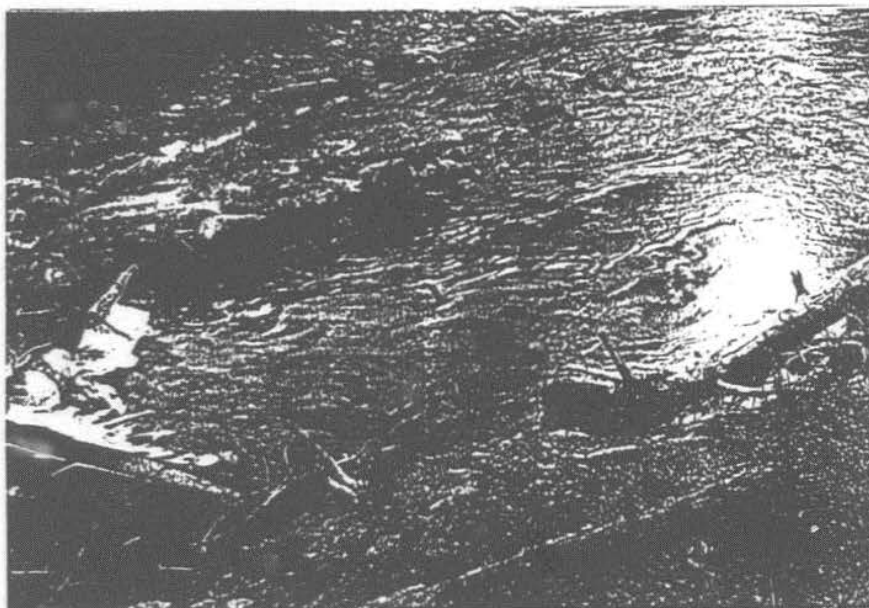
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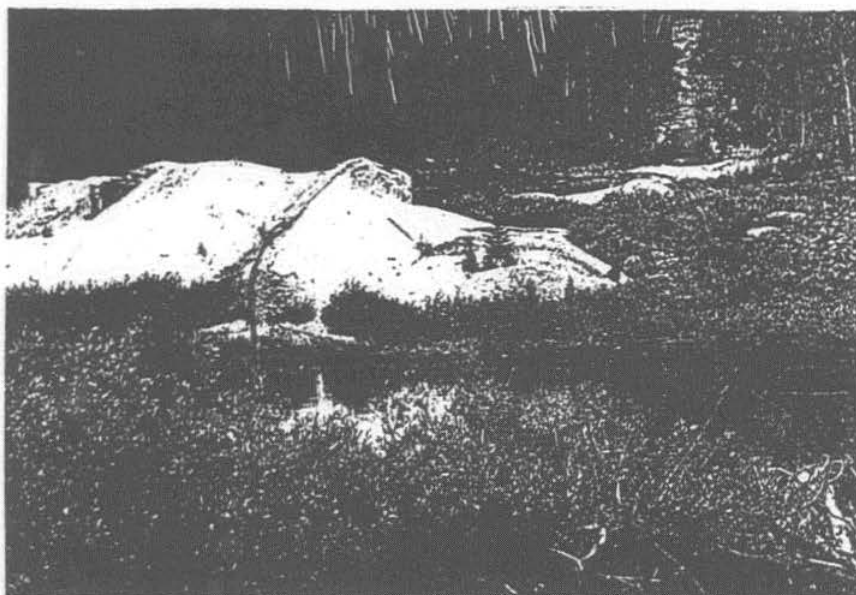
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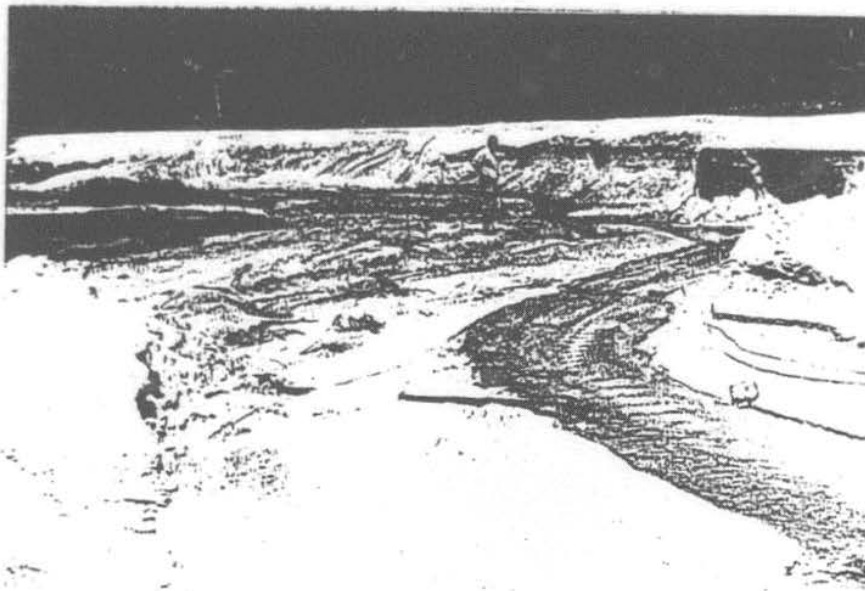
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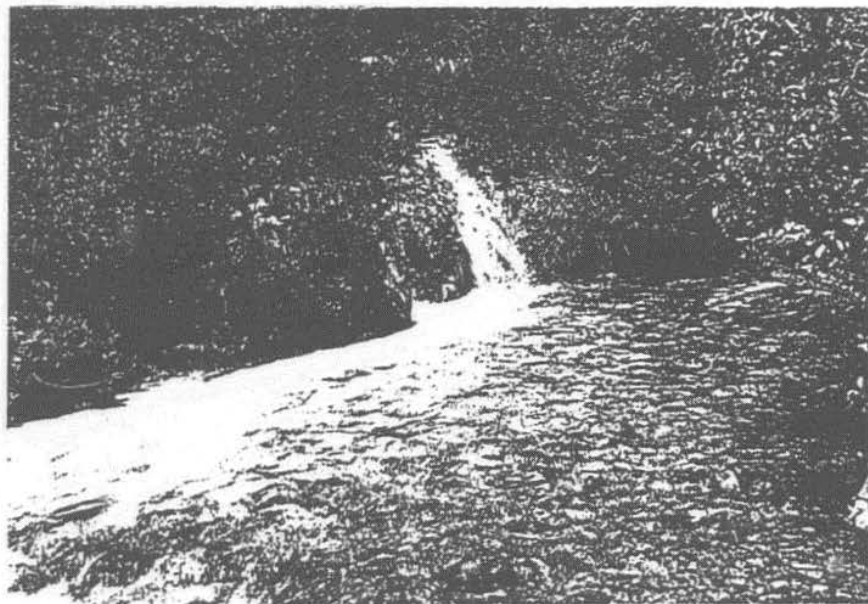
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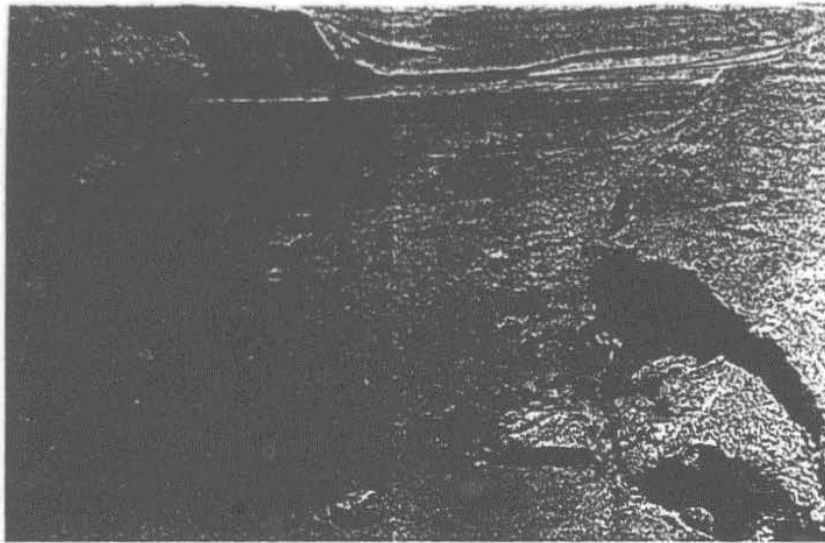
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No. 8 This situation should be corrected immediately and steps taken to ensure it cannot happen in the future.



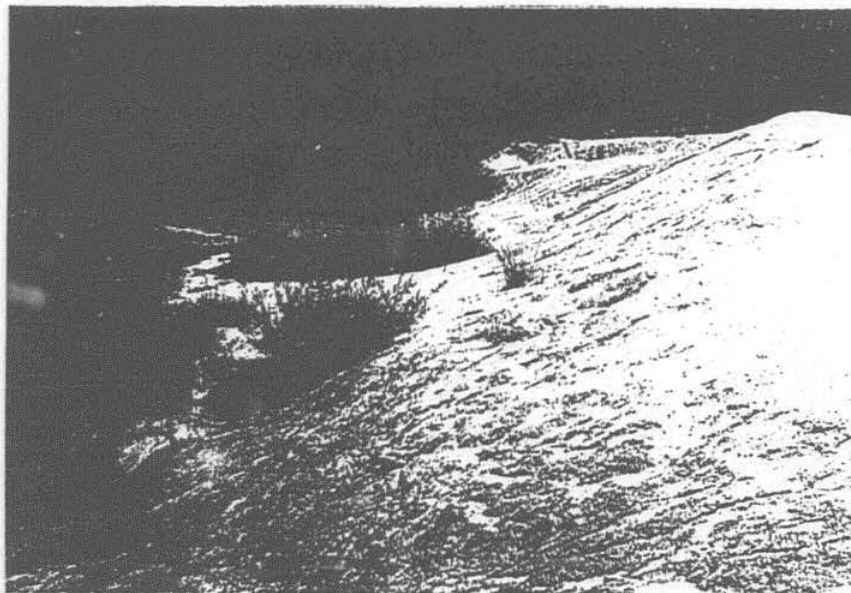
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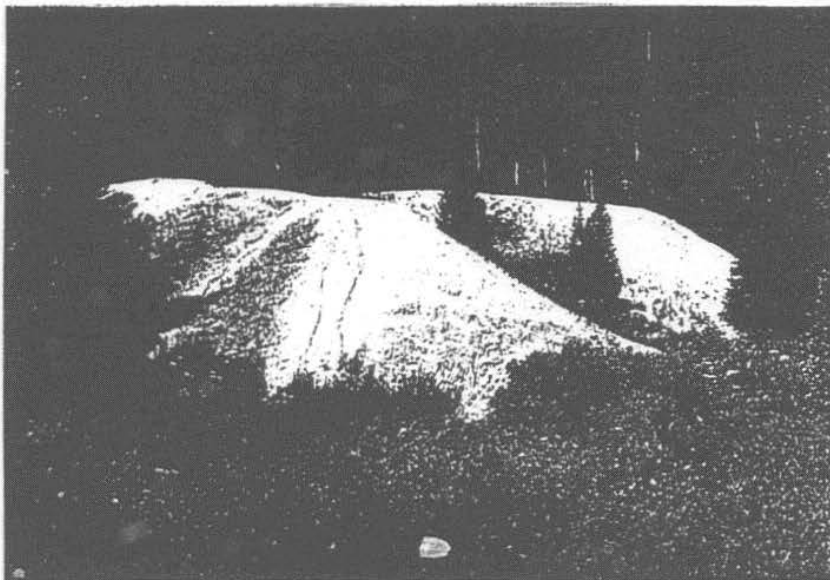
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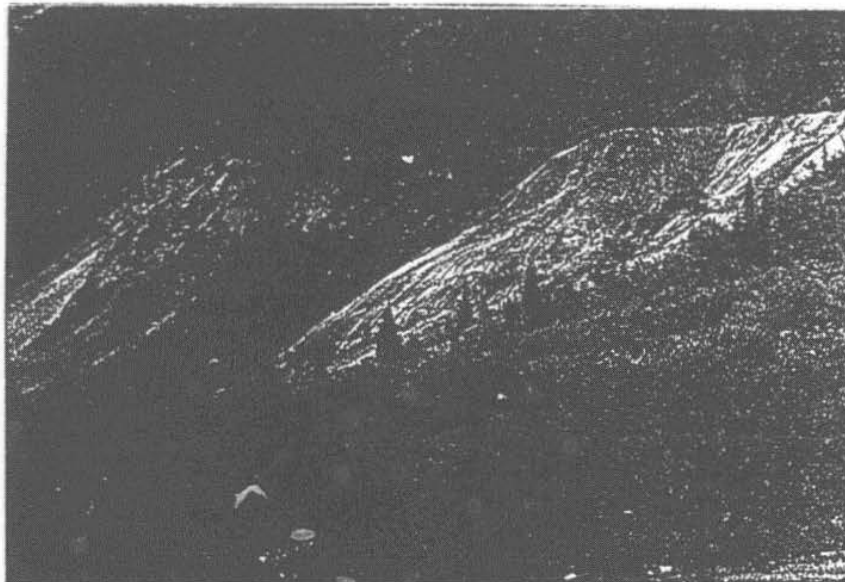
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United States
Department of
Agriculture

Forest
Service

R-4

COPY

To: 2840 Reclamation

Date: AUG 7 1985

Subject: Functional Assistance - Pacific Mine

To: Forest Supervisor, Uinta NF

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done 10-8-85 JLL
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E. R. Browning
E. R. BROWNING
Director
Minerals Area Management

Enclosure

*see inside for documentation
of action taken.*

AUG 07 '85

[Handwritten signature]

*cg D-2
4/3/85*

*bury 2nd copy
10/07/84*



2840

Reclamation Recommendations
for
Pacific Mine
Pleasant Grove Ranger District
Uinta National Forest

by
Ben Albrechtsen
R-4 Reclamation Specialist
July 1985

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Dept of
H
to
Agency
Bureau
Water Pollution
Control

Harry + Ralph
accompanied
7/25/85
(including Beaver)
Obtained both
samples
8-15-85

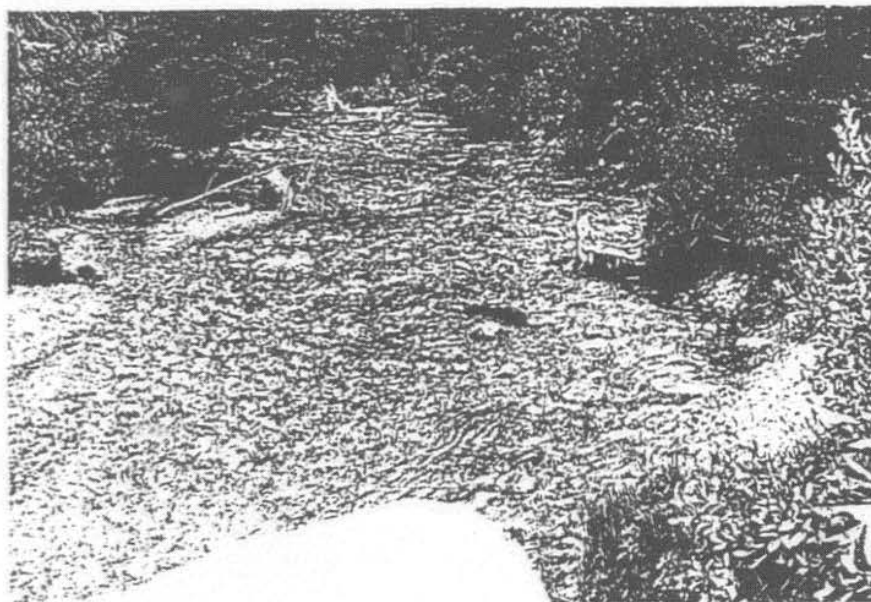
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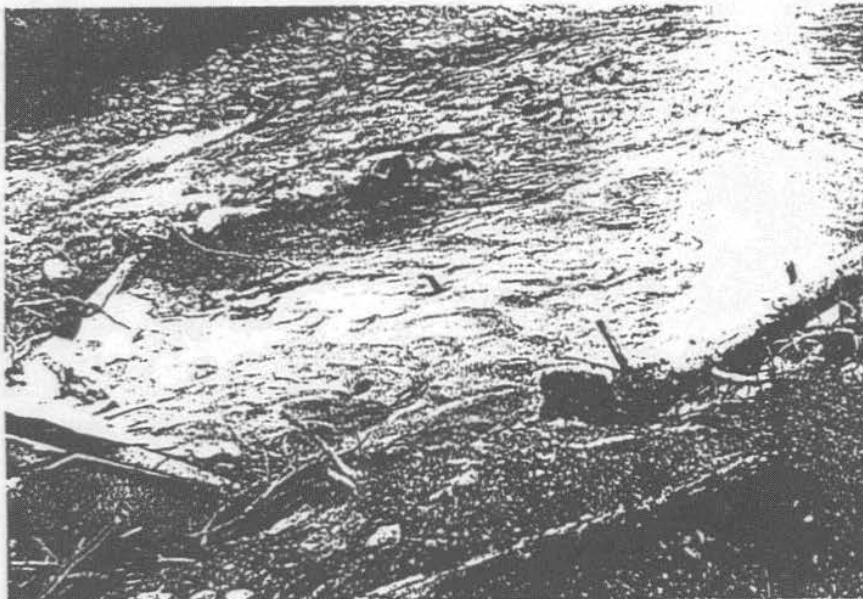
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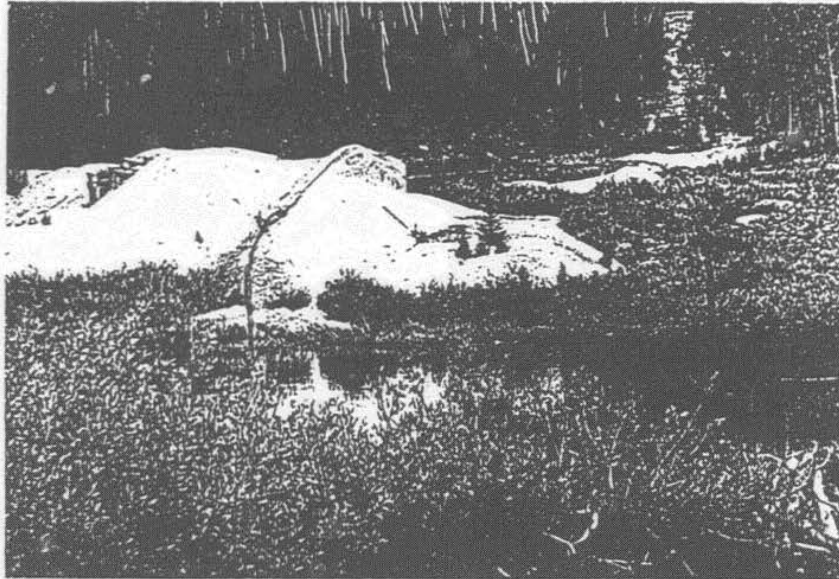
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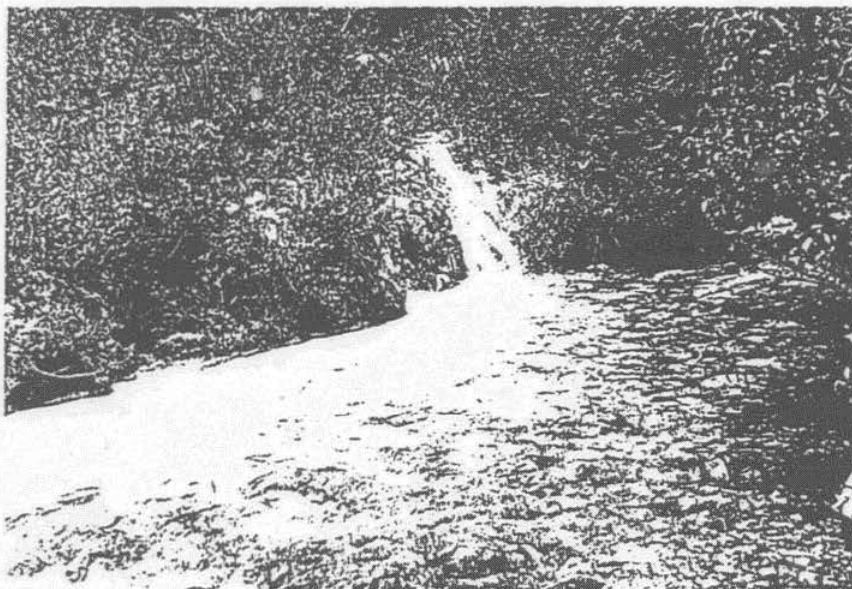
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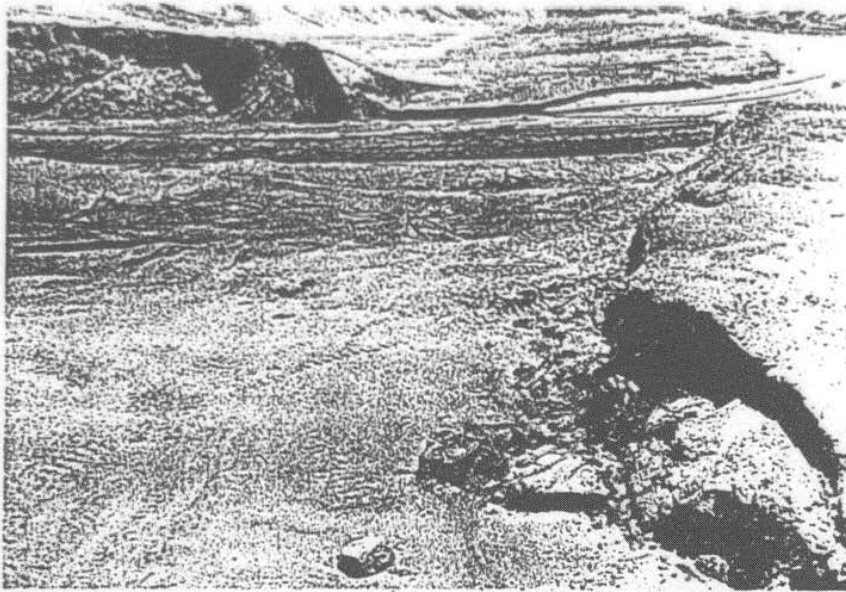
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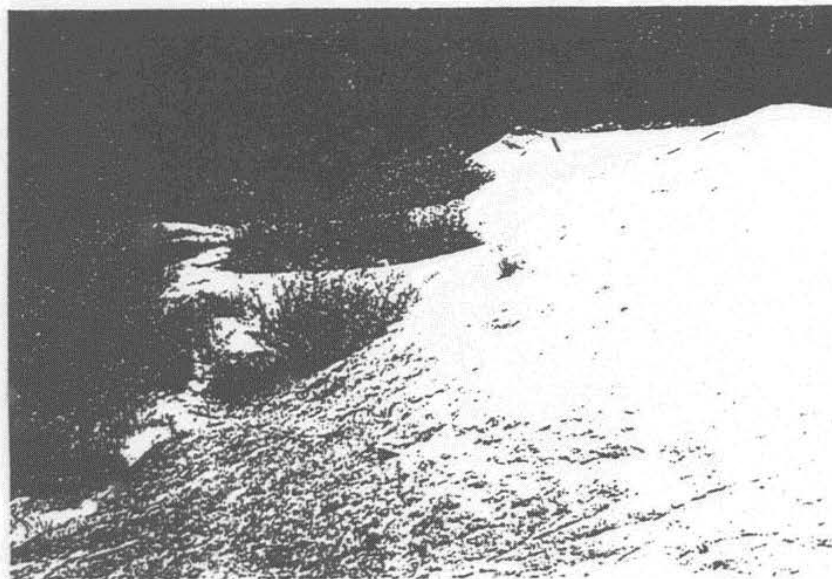
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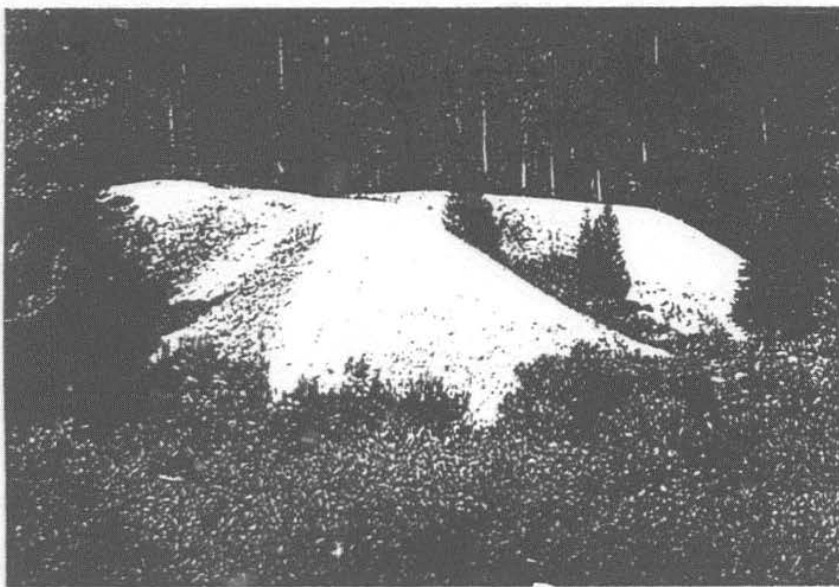
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Forest
Service

R-4

UNIVERSITY OF CALIFORNIA

JUL '89

ny Soc.

4300/2840

Subject:

Old Mining Disturbances - American Fork Canyon

10

Forest Supervisor, Uinta NF

On May 30, 1989, I visited the Pacific Mine, the Lower Bog Mine, and the Mary Ellen Gulch Mines in American Fork Canyon. I was with Paul Skabelund of the SO and two employees of the State of Utah. All of these mines have been inactive for a long time.

The existing water effluent from these mines is not good quality water. Paul Skabelund's data from BYU indicated that these mine effluents are high in one or more of lead, cadmium, or zinc. On the other hand, it is important to note that there are fish in the river only a short distance downstream from any of these mines. The benthic organisms in the streams may suffer a decline during the late summer season.

The Lower Bog Mine is apparently entirely on the Uinta National Forest, but both the Pacific and Mary Ellen Gulch Mines have a mixed federal-private ownership. On these two mines, less than half of the effected area is on National Forest land. This mixed ownership situation probably means that the State of Utah would have to be an active partner if a significant cleanup effort is to be made. The State may have to put legal pressure on the private landowners to spend money to clean up their land. In my view, that is extremely unlikely. Even though these mine water discharges are in violation of State water quality standards, there is little likelihood that the State will act to bring these waters back into compliance with the standards. This is due to the facts that the mine discharges predate the water quality standards law; the mine discharges are in compliance with the State non-degradation clause; and the existing mine discharge is just not all that bad.

The adit flow from the Lower Bog Mine could be collected, piped a short distance, and run through an artificially constructed wetlands. Properly done this treatment could result in improved water quality flowing from the adit to the American Fork River. However, this would be expensive due to the steep rocky terrain, the need to build individual wetland cells, and the need to make significant improvements to the existing road. I estimate the costs at about \$40 to \$75 thousand.

From a technical viewpoint, both the Pacific and Mary Ellen Gulch Mines can be cleaned up and stabilized. It would be expensive, \$40 to \$65 thousand on the Pacific and \$1 to \$2 million on the Mary Ellen Gulch.

These costs make it doubtful that the potential improvement in water quality is worth the cost. However, I do believe that we can affect some material increase in water quality at a relatively low cost by taking steps to keep adit flows or other surface waters from flowing over or through tailings and waste rock piles. This could be done by gathering up these surface waters and



putting them into concrete ditches or plastic pipes and taking them directly to the river. This would prevent further deterioration of surface water quality and would be a useful step at a reasonable cost--a few thousands of dollars at the Pacific Mine and perhaps \$25 thousand at the Mary Ellen Mines. I would suggest that you might consider this action as a fishery improvement project. A hindrance to this mitigation is the mixed ownership; we do not control the lands around these adits.

Every year all of these sites are loosing significant amounts of tailings and waste rock dust through wind erosion.

CONCLUSION AND RECOMMENDATION

We are in a poor position to initiate any cleanup action at the Pacific Mine or the Mary Ellen Gulch Mines because of the ownership situation and the relatively innocuous nature of the problem. On the other hand, it would be useful and relatively cheap to pipe the adit water across the contaminated tailings and waste rock piles. Perhaps that could be done to improve the fisheries.

I recommend that you take no action at the Lower Bog Mine since this mine is a very minor contributor to the overall water quality problems in the North Fork of the American Fork River.

Ben Albrecht

for EUGENE E. FARMER
West-Wide Reclamation
Specialist

cc:

RW - Stender

MAM - Farmer

United States
Department of
Agriculture

Forest
Service

Office of

Reply to: 2800

Date: March 15, 198

Subject: Minerals-Related Nonpoint Pollution Abatement
Needs--Federal Facilities Compliance Program
(Your ltr. 1/28)

To: Regional Forester

We discussed our needs with Gene Farmer and determined that the Uinta will provide updated worksheets for mining related projects at this time. Uinta received \$28,000 of Clean Water Act funding this fiscal year to address the potential problems at mining related sites. With these funds, we plan to determine the water quality impacts at the following:

1. Pacific Mine
2. Mary Ellen Gulch Mining Area
3. Miller Hill Mine
4. Bog Mine
5. North Oakbrush Mine
6. Harker Mine
7. Bingelli Mine
8. Red Ledges Mine
9. Lost Josephine Mine

These studies will also address whether corrective action is needed, what anything should be done to correct the situation, and cost estimates for taking corrective action.

/s/ Don T. Nebeker

DON T. NEBEKER
Forest Supervisor

cc:
V. Stokes
J. Reese
D-1
D-2
D-3



Norman H. Bangerter
Governor
Dee C. Hansen
Executive Director
Dianne R. Nielson, Ph.D.
Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340

August 7, 1990

Mr. Paul Skablund
Uinta National Forest
100 North 88 West
Provo, Utah 84601

Dear Mr. Skablund:

The Utah Abandoned Mine Reclamation Program is concerned with mitigating physical hazards to the public health and safety that occur on abandoned mine sites. We would be able to provide you with plans and specifications for typical closure techniques to secure abandoned mine portals and other work specifications for earthwork, demolition, etc. Possibly a staff member could discuss with you how to draw up reclamation plans for particular sites.

If health hazards are present due to toxic substances, the Utah Department of Health, Environmental Health section, usually takes responsibility.

Possible solutions to the Pacific and Mary Ellen Gulch mines, where extensive tailings dumps are present would be to: 1) route runoff around the dumps and try to stabilize the dumps in place, or 2) remove the dump materials to a lower precipitation site. Removing the dumps would be expensive, logistically difficult and could aggravate the problems present by introducing oxygen into the system. Off-road vehicle use should be prevented at the Pacific Mine tailings area.

From the information in Dr. Merritt's report, elevated levels of cadmium, copper, lead and zinc are present but confined somewhat to localized areas within a mile of the discharge point. Methods to lower these levels are generally prohibitively expensive. It does appear that some of the parameters sampled, particularly copper, lead and zinc increase substantially after flowing through the dump material. Thus, I would recommend preventing, as much as possible, all runoff from flowing over or through the dump.

Please call me if you would like to discuss this further. I would appreciate it if you would keep me informed about the progress of this project.

Sincerely,

Lucia Malin
Senior Reclamation Specialist



State of Utah

DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

Norman H. Bangerter
Governor

Suzanne Dandoy, M.D., M.P.H.
Executive Director

Kenneth L. Alkema
Director

288 North 1460 West
P.O. Box 16690
Salt Lake City, Utah 84116-0690
(801) 538-6121

August 8, 1990

Mr. Paul H. Skabelund
Uinta National Forest
88 North 100 West
Provo, Ut 84603

RE: American Fork River Water Quality

Dear Mr. Skabelund:

This letter is in response to your request for assistance in planning for possible mitigation of water quality problems in the North Fork drainage of the American Fork River. Water quality impairments associated with mine water drainages and mine tailings have been identified on patented and U.S. Forest Service Lands.

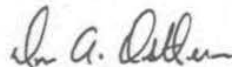
Data have shown that impacts are generally localized around water flowing from adits and across tailings piles and cause elevated concentrations of some heavy metals including cadmium, zinc, and lead. Unstabilized tailings piles appear to be the primary cause as metals are dissolved and carried downstream. Substantial dilution at the main stem of the North Fork reduces concentrations and thus reduces the impacts. However, slight impairments have been demonstrated in macroinvertebrate populations and water chemistry samples.

Our primary concern in this drainage is the protection of water quality and public health along the main stem of North Fork which is a high public use system. As mitigation is planned, it would seem appropriate to stabilize tailings piles adjacent to the stream which are subject to runoff and erosion. Secondary measures could include the diversion of mine drainage away from the tailings, and the construction of wetlands to reduce sediment and metals loads to receiving streams.

Attempts should be made during the planning phase to identify and contact patent holders within the drainage system and determine if cooperative agreements can be established. Without such contacts, any attempts at mitigation may only partially succeed since mine flow often originates on these private land holdings.

We would like to remain involved in your planning process as well as assist, as resources allow, in additional data collection and analysis including water quality parameters, fish tissue analysis, and macroinvertebrate community studies. Please contact Reed Oberndorfer of my staff at 538-6146 for additional information.

Sincerely,

A handwritten signature in dark ink, appearing to read "Don A. Ostler". The signature is fluid and cursive, with the first name "Don" being more prominent.

Don A. Ostler, P.E., Director
Bureau of Water Pollution Control

RYO:pb
SKABELUND.LTR

UINIA NATIONAL FOREST

JUL 9 1991

RIGHT OF ENTRY CONSENT
TO THE PACIFIC MINE SITE

by

Euro-Nevada Mining Company
W. Dan Proctor-Agent

UINIA NF

ACTION	ACTION
FS	WLC
SEC	B & F
AO	CUP
E/MN	PERS
FM	PIO
FP	RES
R & L	✓ DIST D-2
RWL	✓ Paul S. #5
TM	

I, the undersigned, W. Dan Proctor as agent for the Euro-Nevada Mining Company, do hereby consent to the study and determination of hazards to the public's health, safety and general welfare at the site known as the Pacific Mine by the Utah Division of Oil, Gas & Mining, Department of Natural Resources (Division) and its agents, employees or contractors.

The Pacific Mine site is particularly described as in the:

SE4 of Section 22 (unsurveyed), Township 3 South, Range 3 East, SLBM.

The Division expressly assumes liability for any and all injuries sustained by its employees. Furthermore, the Division expressly waives liability of the Landowner for any and all injuries sustained by Division employees.

Except as herein set forth in this right of entry consent, neither the Division nor Landowner shall undertake any activity, either expressed or implied, nor make any representation which purports to bind the other.

It is expressly understood that all costs incurred for studies and tests shall be the sole liability of the Division.

This consent will expire December 31, 1993.

Dated this 27th day of JUNE, 1991

DIVISION OF OIL, GAS & MINING

Euro-Nevada Mining Co.

By: Dianne R. Nielson

By: W. Dan Proctor

Name: Dianne R. Nielson

Name: W. Dan Proctor

Title: Director

Title: Landowner/Agent

Mary Ann Wright
Mary Ann Wright, Administrator
Abandoned Mine Reclamation Program

Euro-Nevada Mining Corporation, Inc.

6121 Lakeside Drive, Suite 240
Reno, Nevada 89511
(702) 825-8890 / Fax (702) 825-4994

October 4, 1991

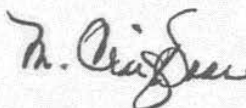
Mr. Robert R. Easton
District Ranger
United States Forest Service
Pleasant Grove Ranger District
P. O. Box 228
Pleasant Grove, Utah 84062

Re: Reclamation Measures in the Vicinity of the Pacific Mine

Dear Mr. Easton:

Thank you for your letter of September 24, 1991 regarding the rehabilitation of certain matters in the vicinity of the Pacific Mine. We have discussed your letter with Mr. W. Dan Proctor, and have this date authorized him to undertake the measures requested in your letter. We have asked Mr. Proctor to complete this work before winter sets into the area and to provide us with a report upon completion. We will provide you with a copy of the report and, at that time, request that you inspect the property and provide us with your acceptance of the work. Of course, should you have any questions or additional concerns, please contact us at your convenience. We thank you for keeping us informed.

Very truly yours,



M. Craig Haase
Executive Vice President

cc: Mr. W. Dan Proctor
Mr. Pierre Lassonde

RECEIVED	
Pleasant Grove Ranger District	
OCT 07 1991	
ON	
RESEARCH	
RECREATION	
REGISTRY	
HRP	
FMQ	
PLANS MGMT	
REC'D	
CO-OP	
ALL	

Paul -

Here are my comments on the water quality survey of mine drainages in Shoshone Mountains and North Fork of the American Fork River.

General

First a couple of general comments. It's always difficult to make conclusive statements about water quality when there are only two or three samples. This is especially true in light of here farmers comments about heavy metals being flushed out of the system at the first of the snowmelt period. Secondly, the Forest needs to define where it wants to go with this study. One objective would be to gather enough evidence for the F.S. to undertake some reclamation projects (eg Pacific Mine tailings stabilization). On the other hand if you want to prove that patented lands are polluting NFS streams you'll need a lot more intensive studies including more chemical analyses, macroinvertebrate sampling and perhaps even fish bioassays. I personally think we'd best leave water quality violations on private lands up to the Water Pollution Control Bureau. My third comment has to do with the way I looked at the water quality data in the following section ("Specific Comments"). I looked at the data only in terms of impacts to beneficial water uses. In these drainages cold water fisheries is the only recognized beneficial use. Thus, small tributary streams without fish are not polluted even if there are extremely high levels of toxic chemicals.

Specific Comments

Zinc from lower bog mine is violating standards in No. 8 American Fork River assuming there are fish in this section of the River. It seems that I recall you saying there is a waterfall that acts as a barrier to fish downstream. If this is the case and there's no fisheries here, then, by definition, there's no pollution.

Lead and zinc appear to be in high concentrations in the effluent from Pacific Mine (portals & runoff from tailings). However, data from site #8 (No. 8 American Fork R. below Pacific Mine) does not clearly indicate standards violation. With this data, I believe you'd have a hard time convincing anyone that lead and zinc from Pacific Mine are impacting beneficial use.

Zinc from Mary Ellen Mine shows a high concentration in Mary Ellen Gulch immediately below the mines. However, by the time it gets to the mouth of Mary Ellen Gulch it's diluted and meets standards. The question is how much of Mary Ellen Gulch contains a fishery. That will determine whether there's pollution in the strict sense.

Summary

In summary I don't see a great deal of impact on beneficial uses as a result of contaminants from the mines. In most cases it appears that mine effluent is diluted by the time it gets to sections of the River that support a beneficial use. Additional sampling during the spring flush may be warranted. However, I'd suggest limiting samples to sites supporting a beneficial use.

Post Script

I talked to Mike Reichert about the data and my strict interpretation of water quality standards and what constitutes violations. I found that Mike takes a much more liberal view than I do. He feels that a stream doesn't necessarily have to be able to support a beneficial use for the standards to apply. For example, the No FK American FK above the waterfall might be in violation of state standards even though fish would not normally be found there.

He suggested that you get someone from his office (and maybe DWK as well) to look at the streams and make their judgements.

WATER QUALITY STANDARDS FOR 3A STREAMS

Arsenic	360 $\mu\text{g/l}$ (1 hour)
Cadmium	3.9 $\mu\text{g/l}$ (1 hour)
Copper	18 $\mu\text{g/l}$ (1 hour)
Lead	82 $\mu\text{g/l}$ (1 hour)
Mercury	2.4 $\mu\text{g/l}$ (1 hour)
Silver	4.1 $\mu\text{g/l}$ (1 hour)
Barium	* —
Chromium	1700 $\mu\text{g/l}$ (1 hour)
Iron	1000 $\mu\text{g/l}$ (1 hour)
Manganese	* —
Selenium	20 $\mu\text{g/l}$ (1 hour)
Zinc	120 $\mu\text{g/l}$ (1 hour)
Sulfate	* —

* No standard found for 3A streams (cold water fisheries)



Norman H. Bangerter
Governor
Dee C. Hansen
Executive Director
Dianne R. Nielson, Ph.D.
Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340

August 7, 1990

Mr. Paul Skablund
Uinta National Forest
100 North 88 West
Provo, Utah 84601

Dear Mr. Skablund:

The Utah Abandoned Mine Reclamation Program is concerned with mitigating physical hazards to the public health and safety that occur on abandoned mine sites. We would be able to provide you with plans and specifications for typical closure techniques to secure abandoned mine portals and other work specifications for earthwork, demolition, etc. Possibly a staff member could discuss with you how to draw up reclamation plans for particular sites.

If health hazards are present due to toxic substances, the Utah Department of Health, Environmental Health section, usually takes responsibility.

Possible solutions to the Pacific and Mary Ellen Gulch mines, where extensive tailings dumps are present would be to: 1) route runoff around the dumps and try to stabilize the dumps in place, or 2) remove the dump materials to a lower precipitation site. Removing the dumps would be expensive, logistically difficult and could aggravate the problems present by introducing oxygen into the system. Off-road vehicle use should be prevented at the Pacific Mine tailings area.

From the information in Dr. Merritt's report, elevated levels of cadmium, copper, lead and zinc are present but confined somewhat to localized areas within a mile of the discharge point. Methods to lower these levels are generally prohibitively expensive. It does appear that some of the parameters sampled, particularly copper, lead and zinc increase substantially after flowing through the dump material. Thus, I would recommend preventing, as much as possible, all runoff from flowing over or through the dump.

Please call me if you would like to discuss this further. I would appreciate it if you would keep me informed about the progress of this project.

Sincerely,

Lucia Malin
Senior Reclamation Specialist

SEP 27 1991

92 1362

No.110418109106

PARTICIPATING AGREEMENT

between

THE UTAH DIVISION OF OIL, GAS & MINING

and

THE USDA FOREST SERVICE, UINTA NATIONAL FOREST

THIS AGREEMENT is made and entered into by and between the Utah Division of Oil, Gas and Mining (Division, also known as the cooperator) under state and federal law and implementing regulations (Section 40-10-1 et seq. U.C.A. and P.L. 95-87, and the USDA Forest Service (FS), under the provisions of the Act of December 12, 1975, 16 U.S.C. 565A.

WITNESSETH:

WHEREAS, the Division is the designated state agency responsible for implementation of a statewide program for the reclamation of abandoned mines, and

WHEREAS, both parties are interested in the conservation of our nation's natural resources, and inasmuch as that interest extends to the protection and management of lands that are threatened by the adverse effects of abandoned mines, and

WHEREAS, the abandoned Pacific Mine, the Lower Bog Mine, the Miller Hill Drain Tunnel site, the Mary Ellen Gulch Mine and other smaller unnamed sites in American Fork Canyon are FS Region 4 areas of concern for the abatement of pollution in the Wasatch Mountains of Utah, and

WHEREAS, the Uinta National Forest contains a number of acres of mineral mine wastes from these abandoned mines which have high levels of lead, zinc, cadmium and other heavy metals, causing highly acidic drainage to enter the American Fork River, and

WHEREAS, to manage and protect the lands and waters in the vicinity of abandoned mines, their effects need to be studied and remedies need to be proposed, and

WHEREAS, it is mutually advantageous to the parties herein to share in the study and correction of abandoned mine impacts on the environment and propose remedies for affected areas within the Uinta National Forest and publish a report thereon.

NOW THEREFORE, in consideration of the above, the parties agree to cooperate on a reclamation project the total direct value of which is estimated at \$4,750, to be equally divided between the parties as shown in the Attachment.

A. THE FS SHALL:

1. Provide initial advice and assistance as needed to formulate and meet project objectives.
2. Provide aerial photography and other supplies at their (FS) costs to meet project needs efficiently.
3. Reimburse the Division for the cost of the project, up to \$2,375 as provided for in the attached financial project plan, upon delivery of the completed report and upon receipt of an itemized listing of project expenditures. Advance payments shall not be made.
4. Designate Paul H. Skabelund or his designated replacement to represent its interest in this effort.
5. Provide the Division with permission to study the areas, of abandoned mine problems which it manages, for solutions to the acid mine drainage problems.

B. THE DIVISION SHALL:

1. Provide manpower, equipment and supplies through its Abandoned Mine Reclamation Program to complete the selection and management of abandoned mine investigation and remediation proposals as outlined in the project work plan.
2. Provide funding and services up to \$7,886 as shown in the attached financial project plan for completion of the project as outlined in the project work plan.
3. Prepare and present to the FS a report that summarizes the results of the field investigations and proposes plans and cost estimates for remediation of the abandoned mine problems as outlined in this agreement.
4. Be alert to the presence of other abandoned mine problems known or suspected to exist on the Uinta National Forest in the process of performing the work plan.

5. Provide the Uinta National Forest with any other information collected incidental to the completion of this project.
6. Designate Mary Ann Wright or her replacement as the Division employee responsible for carrying out its part of this agreement.
7. Bill the Forest Service upon completion of the project.
8. Coordinate with any landowners as necessary to obtain permission to enter and study the past effects of abandoned mine lands on private lands adjacent to the FS lands.
9. Coordinate with other state agencies as necessary to accomplish the proposed work.
10. Give USDA Forest Service or the Comptroller General, through any authorized representative, access to and right to examine all records, books, papers or documents related to the award.

C. IT IS MUTUALLY AGREED AND UNDERSTOOD THAT:

1. The work under this agreement shall be completed no later than December 31, 1992.
2. The FS and the Division shall work together to reach a mutually acceptable reclamation plan for the American Fork sites.
3. The FS or the Division, in writing, may terminate the agreement in whole, or in part, at any time before the date of expiration, whenever it is determined that the other party has materially failed to comply with the conditions of this agreement. The other party shall not incur any new obligations for the terminated portion of the agreement after the effective date, and shall cancel as many obligations as is possible. Full credit shall be allowed for the FS share of the obligations incurred to the effective date and all non-cancelable, properly incurred obligations by the cooperating party (Division) prior to termination.

4. Any monies that are payable from the United States under this agreement to any person or legal entity not an agency or subdivision of a State or local government may be subject to administrative offset for the collection of any debt the person or legal entity owes to the United States. Information on the person's or legal entity's responsibility for a commercial debt owed the United States shall be disclosed to consumer or commercial credit reporting agencies.
5. The cooperator (Division) shall comply with Title VI of the Civil Rights Act of 1964, that no person in the United States shall, on the ground of race, color, handicap or national origin, be excluded from participation, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the recipient receives Federal financial assistance and will immediately take any measures necessary to effectuate this agreement.
6. Improvements placed on National Forest land at the direction of either of the parties, shall thereupon become the property of the United States, and shall be subject to the same regulations and administration of the FS as all other National Forest improvements of a similar nature.
7. This agreement in no way restricts the FS from participating with other public or private agencies, organizations, and individuals or from accepting contributions and/or gifts for the improvement, development, administration, operation and preservation of this or any other project.
8. No part of this agreement shall entitle the cooperator (Division) to any share or interest in the project other than the right to use and enjoy the same under the existing regulations of the FS.

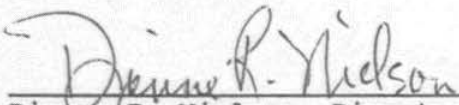
9. No member of, or Delegate to Congress, shall be admitted to any share or part of this agreement, or any benefits that may arise therefrom; but this provision shall not be construed to extend to this agreement if made to a cooperation for its general benefit.
10. Nothing herein shall be considered as obligating the FS to expend or as involving the United States in any contract or other obligations for the future payment of money in excess of appropriations authorized by law and administratively allocated for this work.
11. Persons provided as contributed labor under this agreement shall be considered as federal employees for the purposes of tort claims and compensation for work injuries.
12. This agreement may be revised as necessary by mutual consent of both parties, by the issuance of a written amendment, signed and dated by both parties.

Page 6
Agreement

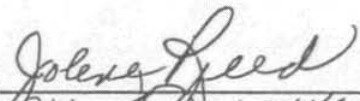
The parties hereto have executed this agreement as of the last date written below:

DIVISION OF OIL, GAS & MINING

USDA FOREST SERVICE


Dianne R. Nielson, Director

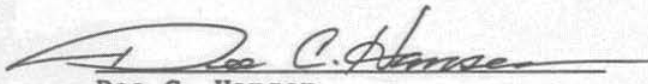
By:


Forest Supervisor

Date:

9/18/91

DEPARTMENT OF NATURAL RESOURCES


Dee C. Hansen
Executive Director

DIVISION OF OIL, GAS & MINING


Carl Roberts, Budget Officer

DIVISION OF FINANCE


Gordon L. Crabtree, Director

Date:

9/25/91

Agreement Attachment
Page 1AMERICAN FORK CANYON ABANDONED MINE STUDY
MOA PROJECT BUDGET AND PLAN

PHASE I

Task 1	Contracted hydrologic analysis: Site analyses for three sites.		
	Hydrologist	20 hours @ \$50/hour	\$1,000
	Technician	25 hours @ \$25/hour	\$ 625
	Travel	lump sum	\$1,000
	Supplies and equipment	lump sum	\$ 400
Task 2	Contracted hydrologic design effectiveness: Application of technology assessment, design and cost proposal development.		
	Hydrologist	20 hours @ \$50/hour	\$1,000
	Drafter	5 hours @ \$25/hour	\$ 125
Task 3	Hydrologic analysis report.		
	Hydrologist	8 hours @\$50/hour	\$ 400
	Clerical	10 hours @ \$20/hour	\$ 200
		TOTAL	\$4,750

PHASE II

USFS and Division coordination to reach an acceptable reclamation plan.

PHASE III

Task 4 Division design and construction specification
development.

Program Administrator	60 hours	@\$20/hour	\$1,200
Sr Reclamation Spec'lst	160 hours	@13/hour	\$2,080
Clerical	20 hours	@8/hour	<u>\$ 160</u>
		SUBTOTAL	\$3,440
Benefits		@ 33%	\$1,135
Travel		lump sum	\$ 250
Other Direct			\$ -0-
Current Expense	15% of Salaries & Benefits (\$4,575)		<u>\$ 686</u>
		TOTAL	\$5,511

PHASE IV

Review by both parties and implementation of plan.

BUDGET SUMMARY

FOREST SERVICE CONTRIBUTION

Value of contributed labor	\$1,000
50% share of contracted costs ¹	\$2,375

SUBTOTAL	\$3,375
----------	---------

DIVISION CONTRIBUTION

Value of contributed labor	\$5,511
50% share of contracted costs	\$2,375

SUBTOTAL	\$7,886
----------	---------

PROJECT TOTAL	\$11,261
---------------	----------

Total FS Share	50	% of Direct Consulting Costs
Division Share	50	% of Direct Consulting Costs

¹Estimated payment to the Division. Reimbursement will be made only upon actual expenses incurred by the Division, not to exceed estimated payment.

BUDGET SUMMARY

FOREST SERVICE CONTRIBUTION

Value of contributed labor	\$1,000
50% share of contracted costs ¹	\$2,375

SUBTOTAL	\$3,375
----------	---------

DIVISION CONTRIBUTION

Value of contributed labor	\$5,511
50% share of contracted costs	\$2,375

SUBTOTAL	\$7,886
----------	---------

PROJECT TOTAL	\$11,261
---------------	----------

Total FS Share	<u>50</u>	% of Direct Consulting Costs
Division Share	<u>50</u>	% of Direct Consulting Costs

¹Estimated payment to the Division. Reimbursement will be made only upon actual expenses incurred by the Division, not to exceed estimated payment.



Norman H. Bangert
Governor
Dee C. Hansen
Executive Director
Dianne R. Nielson, Ph.D.
Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

355 West North Temple
3 Triad Center, Suite 360
Salt Lake City, Utah 84180-1203
801-538-5340

UTAH DIVISION OF OIL, GAS AND MINING FACSIMILE TRANSMISSION COVER SHEET

DATE: 5-8-92
FAX #: 1-375-0821
ATTN: Paul Skeebland
COMPANY: U.S.F.S
FROM: Mark Mesch
DEPARTMENT: Oil Gas + Mining
NUMBER OF PAGES BEING SENT (INCLUDING THIS ONE): 8

If you do not receive all of the pages, or if they are illegible, please call (801) 538-5340.

We are sending from a Murata facsimile Machine. Our telecopier number is (801) 359-3940.

MESSAGES:

Please Review and comment on the scope of work in this contract.

Lidstone & Anderson, Inc.
American Fork Hydrology Contract
Page 8

ATTACHMENT C

SCOPE OF WORK

- C.1 GENERAL: The Scope of Work includes a hydrological analysis of water quality associated with three metal mine sites; development of design recommendations with cost proposals, to reduce impacts of mine water entering the American Fork River, and preparation of a hydrological report discussing the water quality analysis and the preferred design recommendation. Each segment of the WORK is divided into the following Tasks:
- Task I Hydrological Analysis (water quality)
- Task II Hydrological Design: Application of technology assessment, design and cost proposal development
- Task III Hydrological Report, Recommended Design
- C.1.2 THE WORK: The objective of the WORK is: I) to conduct a hydrological analysis (water quality) to determine impacts of mine water to off site water sources; II) based on Task I findings, develop a site flow cost, aesthetically pleasing, and hydrologically stable design recommendations, with cost proposals; and III) submit a written hydrological report discussing the analyses performed, data collected and results obtained as well as preferred design recommendations.
- C.1.3 If technical deficiencies or engineering related problems are encountered within the Scope of Work and technical specifications during future bidding or construction activity, the OWNER will require further information or verification of assumptions from the CONTRACTOR. It is expected that if such deficiencies are found, the CONTRACTOR will act to alleviate and resolve any conflicting, missing or unsubstantiated information found within the Construction Specifications.
- C.1.4 It is not the intent of the OWNER to bind the CONTRACTOR to work not included as part of the WORK. The intent of the OWNER is to require the CONTRACTOR to complete the specifications accurately and in the detail sufficient to perform the construction work.

C.2 TASK I - HYDROLOGICAL ANALYSIS, WATER QUALITY

The purpose of Task I is to conduct the necessary hydrological analyses to determine the current water quality conditions at the Pacific Mine, Mary Ellen Gulch, and the Lower Bog Mine and their associated impacts to the American Fork River. This will involve sampling for the following Total metals: arsenic, barium, cadmium, chromium, lead, mercury, nitrate (as N), selenium, silver, copper, iron, manganese, sulfate, zinc, and total dissolved solids (TDS). Additionally, the following field measurements will be taken: pH, conductivity, dissolved oxygen, temperature, color and rate of flow. Samples will be taken at the following locations: A) portal openings (3 samples); B) as water leaves the tailings piles (3 samples); C) at the beaver pond adjacent to the Pacific Mine (2 samples); D) locations above and below mine sites along the American Fork River (3 samples). It is estimated that eleven points will be sampled during the low flow period. Exact sampling points will be identified on a quad map of the area.

C.3 TASK II - HYDROLOGIC DESIGN, APPLICATION OF TECHNOLOGY ASSESSMENT, COST PROPOSAL

CONTRACTOR will prepare a suite of site specific design alternatives based on TASK I findings to reduce the impacts of mine water entering the American Fork River. Low cost and an aesthetic, natural appearance are critical design factors in addition to effective performance.

- C.3.1 Structural design specifications of the recommended design will be presented in a manner to fit the OWNER's contract bid specifications.

C.4 TASK III - HYDROLOGICAL ANALYSIS REPORT, DESIGN RECOMMENDATIONS

- C.4.1 CONTRACTOR will submit to the OWNER a written report discussing the hydrological findings, (Task I), design options, with associated costs (Task II), and the recommended design, containing, if necessary, formatted Technical Specifications and Site Specific Requirements.

- C.4.2 CONTRACTOR will provide these site specific specifications to be compatible with the 0300 Section format used by the OWNER. When the WORK specified is not work previously conducted by the OWNER, CONTRACTOR will provide technical directions, in standard ASTM or comparable format and compatible with the 0200 Section format used by the OWNER. As part of the WORK Specifications, the following is included as part of the WORK:
- C.4.3 Detailed areas for specific construction and grading will be drawn at a scale and with contour intervals as appropriate and approved by the OWNER.
- C.4.4 When 95% of the final design WORK is complete, CONTRACTOR will accompany the OWNER'S representative to the project site for the purpose of field verification of the design plans.

End of Attachment C

ATTACHMENT D
SCHEDULE OF PRICES & COST SHEETS

- D.1 FIXED NOT-TO-EXCEED PRICE AMOUNT
- D.1.1 CONTRACTOR hereby agrees to perform the WORK, PART I, II, and III, as described in this Agreement and the OWNER agrees to pay CONTRACTOR in the amount not to exceed \$ 4,750.00 for said WORK, as a FIXED NOT-TO-EXCEED AMOUNT.
- D.1.2 OWNER shall pay amounts invoiced only at UNIT COST PRICES submitted by the CONTRACTOR on a regular basis.
- D.2 UNIT COST PRICES
- D.2.1 Unit prices provided by the CONTRACTOR and approved by the OWNER are attached to and considered part of this agreement. These are considered UNIT COST PRICES for each line item and the FIXED NOT-TO-EXCEED PRICE for the total sum of all items contained in the WORK.

Lidstone & Anderson, Inc.
American Fork Hydrology Contract
Page 11

D.2.2 COST SUMMARY SHEETS

D.2.3 The following cost summary sheets were completed from information supplied by the CONTRACTOR in negotiations with the OWNER and are binding as part of the AGREEMENT upon execution.

D.2.4 TOTAL FIXED-PRICE COST

Task I	<u>HYDROLOGICAL ANALYSIS, WATER QUALITY</u>	\$3,025.00
Task II	<u>HYDROLOGIC DESIGNS, APPLICATION OF TECHNOLOGY ASSESSMENT, COST PROPOSALS</u>	\$1,125.00
Task III	<u>HYDROLOGICAL ANALYSIS REPORT, DESIGN RECOMMENDATION</u>	\$ 600.00
Total Fixed Not-To-Exceed Price		\$4,750.00

D.2.5 BREAKDOWN OF COSTS BY TASK

TASK I HYDROLOGICAL ANALYSIS, WATER QUALITY

<u>Item</u>	<u>Units</u>	<u>Rate</u>	<u>Extension</u>
Hydrologist	20 hr	\$50	\$1,000.00
Technician	25 hr	\$25	\$ 625.00
Travel		lump sum	\$1,000.00
Supplies and equipment		lump sum	\$ 400.00
Total Task I			\$3,025.00

TASK II - HYDROLOGIC DESIGN, APPLICATION OF TECHNOLOGY ASSESSMENT, COST PROPOSALS

<u>Item</u>	<u>Units</u>	<u>Rate</u>	<u>Extension</u>
Hydrologist	20 hr	\$50	\$1,000.00
Drafter	5 hr	\$25	\$ 125.00
Total Task II			\$1,125.00

TASK III HYDROLOGICAL ANALYSIS REPORT, DESIGN RECOMMENDATIONS

<u>Item</u>	<u>Units</u>	<u>Rate</u>	<u>Extension</u>
Hydrologist	8 hr	\$50	\$ 400.00
Clerical	10 hr	\$20	\$ 200.00
Total Task III			\$ 600.00

TOTAL ALL TASKS \$4,750.00

End of Attachment D

Lidstone & Anderson, Inc.
American Fork Hydrology Contract
Page 12

ATTACHMENT E

TIME SCHEDULE

- E.1 TIME SCHEDULE: Schedule is shown in Attachment E.1.1 in calendar form, on a daily schedule, the activities required for the WORK described in this Agreement for each activity based on actual start date for the WORK.
- E.1.1 Constraints and float allowed for in the calendar are identified and explained for in the schedule. Considerations for weather, access and normal delays are accounted for in these constraints. Deviations from this schedule must be approved in writing by OWNER. All deliverables are due by August 31, 1992.

June - July - August

<u>Task I</u>	1 - 30
<u>Task II</u>	1 - 31
<u>Task III</u>	1 - 31

End of Attachment E

ATTACHMENT F

SERVICES AND FACILITIES PROVIDED BY OWNER

- F.1 OWNER shall provide the following services for the CONTRACTOR with respect to the WORK required:
- F.2 Any site-specific information that the OWNER has that would be helpful to the CONTRACTOR in accomplishing the WORK.
- F.3 OWNER'S representative will be available to accompany the CONTRACTOR to facilitate location of the site features, assist with sample collection, collaborate on design, and respond to questions.

- F.4 Access to resources in the OWNERS possession that may aid in the completion of the WORK, such as:
- a) All project and site files, project correspondence, slides, photographs, and any maps relating to the project area.
- F.5 Funds for the analysis of water samples at the State of Utah Water Laboratory will be the responsibility of the OWNER and are not included in this contract amount.

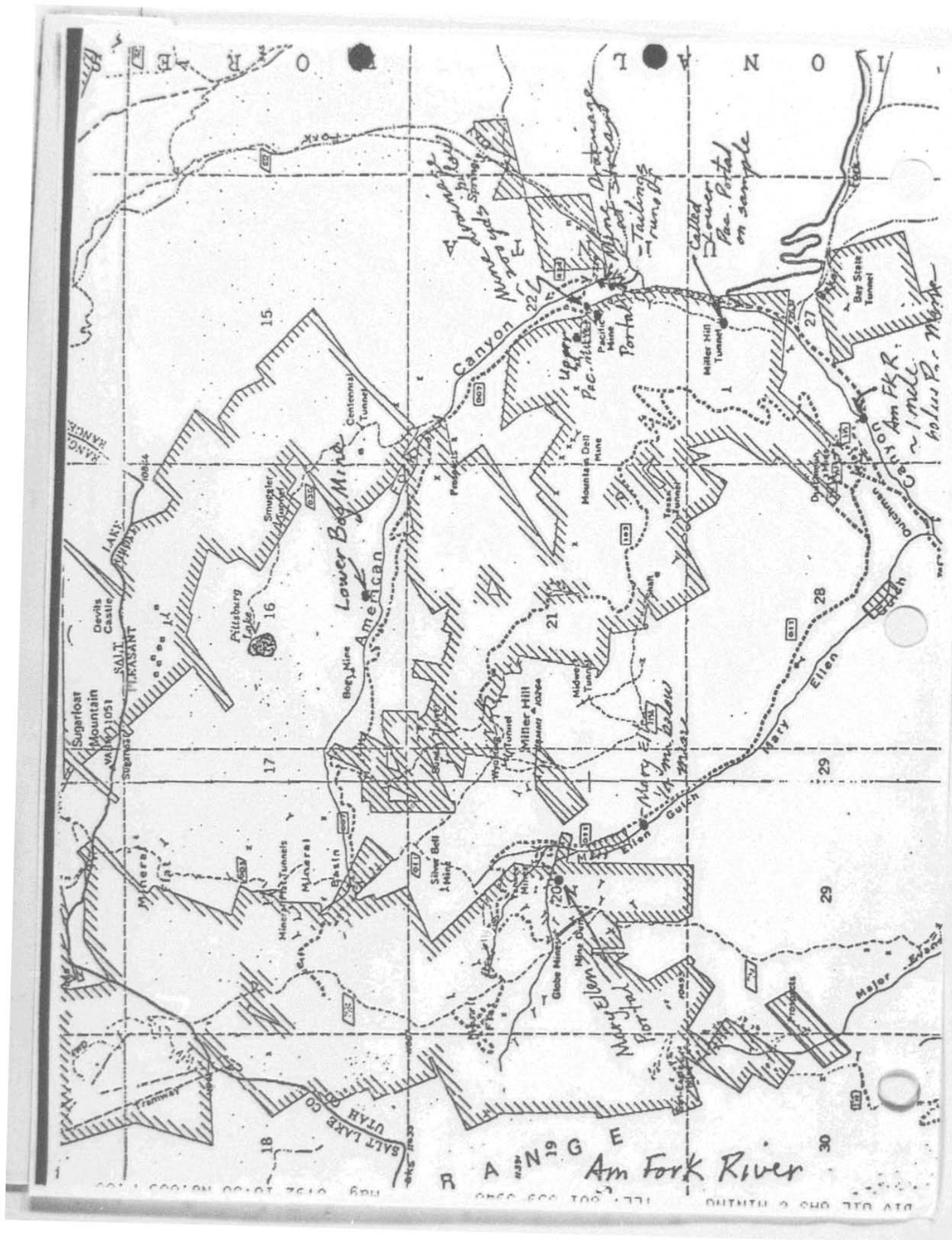
End of Attachment F

ATTACHMENT G

AMENDMENTS TO THE AGREEMENT

- G.1 OWNER shall require amendments to the Agreement to be in the form of a change order, signed by both parties and similar in form to the change order shown in this Attachment.
- G.2 Change orders shall become attached to and part of the Agreement under the terms of the Agreement with changes as stipulated on the change order and shall not release the CONTRACTOR from any other terms or conditions that apply and are a part of the Agreement.

End of Attachment G





Norman H. Bangerter
Governor
Dee C. Hansen
Executive Director
Dianne R. Nielson, Ph.D.
Division Director

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340

January 20, 1993

Mr. Paul Skabelund
Uinta National Forest
88 West 100 North
Provo, Utah 84601

PHS
UINTA NATIONAL FOREST

JAN 25 1993

CC: D-2

Dear Mr. Skabelund:

Re: American Fork Mine Site Analyses and Reclamation
Recommendations

Enclosed please find one bound original and one unbound copy of Lidstone & Anderson's American Fork Hydrology and Water Quality Study. The report, in addition to supplementing the earlier water quality work of Merritt, examines the geochemistry of the area, identifies biological, geochemical, and hydrological controls at each site, and develops mitigation alternatives and recommendations. The report also acknowledges a need for further data collection and analysis. Below I have attempted to summarize the salient issues in the report.

ABIOTIC AND BIOTIC FACTORS

Two abiotic factors, geological and hydrological, are operating to reduce the severity of the off site impacts of the Pacific Mine, mines in Mary Ellen Gulch, and the Lower Bog Mine: 1) high buffering capacity due to a host rock rich in carbonates; and 2) high dilution ratios, up to 33:1 at the Lower Bog Mine. These factors result in a change in pH values measured at the mine portals and downstream of 5.1 to 7.52 at the Lower Bog Mine, 6.5 to 8.02 at the Pacific Mine, and 6.95 to 7.95 at Mary Ellen Gulch.

The beaver pond at the Pacific mine appears to play a significant biotic role in removing trace elements from the portal effluent, specifically, zinc, cadmium, and lead. The effectiveness of the beaver pond clearly identifies its potential role in any reclamation activity undertaken at the Pacific Mine.

MITIGATION ALTERNATIVES

Pacific Mine

Based on the analysis of the data collected, reclamation at the Pacific mine is the highest priority. Two sources of

Page 2
Mr. Paul Skabelund
January 20, 1993

These problems could be addressed in two or three phases. Phase one would route all portal drainage off the tailings pile and via a riprap ditch into the beaver pond. Phase two would isolate, recontour and treat, topsoil, and revegetate the tailings dumps. A third phase would develop a wetland above the beaver dam to provide additional treatment to the portal effluent if water sampling after completion of phase one indicated a decrease in the ability of the beaver pond to treat the portal discharge adequately.

Lower Bog Mine

Due to the inaccessibility of the Lower Bog mine, the limited magnitude of the problem it presents, and the high dilution ratio (33:1), no reclamation action is recommended.

Mary Ellen Gulch Mines

A suite of problems exist at the Mary Ellen Gulch site ranging from trace metal contamination in the creek to active mining exploration in the Belorophan mine and at the Yankee dumps. Samples taken in Mary Ellen Creek identified contamination but an insufficient number of samples were collected to fully characterize the source. The sample identified as AF#7 taken from the most northerly portal on the mine bench did not show elevated metals except for zinc, suggesting some other source of contamination exists. This could possibly be from the tailings piles or the mining activity occurring at the Belorophan mine. The Utah Division of Oil, Gas and Mining's Minerals Program issued a Small Mining Operations permit for the "Yankee Project" in August of 1992, after we noticed mining activity taking place while sampling in the area. The operator, James Warr, was advised by DOGM's Minerals Program in a July 27, 1992 letter of the following issues: 1) that the Forest Service was very concerned about any off site impacts to Mary Ellen Creek and surrounding areas; 2) that if old workings were developed a UPDES permit would be required from the Division of Water Quality; and 3) that the mine dumps had been placed on the CERCLIS list and that the operators might be responsible for some expensive CERCLA cleanup.

Due to the complexity of the situation at the Mary Ellen Gulch site, further study is warranted to identify the specific source(s) of contamination and allow for some resolution to occur with regards to the mining activity prior to developing reclamation alternatives for this site.

Page 3
Mr. Paul Skabelund
January 20, 1993

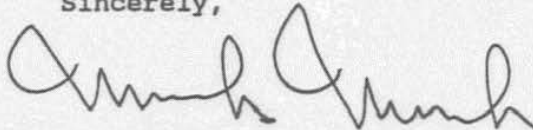
Miller Hill Tailings

Water sampling was not performed at this site. No portal discharge is occurring, and the adverse effects are more a result of erosive conditions along the toe of the pile during high water stream flows. Tailings samples taken by the Forest Service and analyzed by Utah State University Soil Testing Laboratory for crop production/vegetation success are within the range for plant establishment and growth. Revegetation, however, does not remedy the problem that the location of the tailings presents to the North Fork of American Fork. Based on the rather small areal extent of the tailings pile and the ease of access, removal may be the best alternative.

Utilizing the tailings as road surface material may be an effective form of disposal. However, the following precautions are warranted. Testing for total soluble metals is recommended. Soluble metals leaving road surfaces during rain storms or as snowmelt could be problematic and affect off site areas. Spreading the tailings out over a large area (i.e. roadway) would also increase the oxidation rate by increasing the surface area of the tailings, as opposed to keeping the tailings confined as a single deep pile. Tailings should be mixed with locally obtained limestone material prior to placement as road surface. This would continue to buffer the tailings material once in place on the road surface. Finally, any road sites selected for tailings placement should be situated away from water courses.

Using the report's recommendations for the Pacific mine, I will develop construction costs for the work phases. After you have had time to review the report we can arrange for a meeting to discuss the report and the direction the Forest Service wishes to take in addressing the reclamation at these sites.

Sincerely,



Mark Mesch
Reclamation Specialist
Abandoned Mine Reclamation Program

MRM
Enclosures
WP.Skabelun.Let

PART IV

Sample Results From Water, Soil, and Tailings
at the
Pacific Mine, Mary Ellen Gulch Mine and the Lower Bog Mine
(cronological order)

TABLE 2.14.2
NUMERIC CRITERIA FOR AQUATIC WILDLIFE

Parameter	Aquatic Wildlife			
	3A	3B	3C	3D
PHYSICAL				
TOTAL DISSOLVED GASES	(1)	(1)		
DISSOLVED OXYGEN (MG/L) (2)				
30 DAY AVERAGE	6.5	5.5	5.0	5.0
7 DAY AVERAGE	9.5/5.0	6.0/4.0		
1 DAY AVERAGE	8.0/4.0	5.0/3.0	3.0	3.0
MAX. TEMPERATURE (C)	20	27	27	
MAX. TEMPERATURE CHANGE (C)	2	4	4	
pH (RANGE)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
TURBIDITY INCREASE (NTU)	10	10	15	15
METALS (3)				
(ACID SOLUBLE, UG/L) (4)				
ARSENIC (TRIVALENT)				
4 DAY AVERAGE	190	190	190	190
1 HOUR AVERAGE	360	360	360	360
CADMIUM (5)				
4 DAY AVERAGE	1.1	1.1	1.1	1.1
1 HOUR AVERAGE	3.9	3.9	3.9	3.9
CHROMIUM (HEXAVALENT)				
4 DAY AVERAGE	11	11	11	11
1 HOUR AVERAGE	16	16	16	16
CHROMIUM (TRIVALENT) (5)				
4 DAY AVERAGE	210	210	210	210
1 HOUR AVERAGE	1700	1700	1700	1700
COPPER (5)				
4 DAY AVERAGE	12	12	12	
1 HOUR AVERAGE	18	18	18	18
CYANIDE (FREE)				
4 DAY AVERAGE	5.2	5.2	5.2	
1 HOUR AVERAGE	22	22	22	22
IRON (MAXIMUM)	1000	1000	1000	1000
LEAD (5)				
4 DAY AVERAGE	3.2	3.2	3.2	3.2
1 HOUR AVERAGE	82	82	82	82

TABLE 2.14.2, CONTINUED

Parameter	Aquatic Wildlife			
	3A	3B	3C	3D
METALS (CONTINUED)				
(ACID SOLUBLE, UG/L)				
MERCURY				
4 DAY AVERAGE	0.012	0.012	0.012	0.012
1 HOUR AVERAGE	2.4	2.4	2.4	2.4
NICKEL (5)				
4 DAY AVERAGE	160	160	160	160
1 HOUR AVERAGE	1400	1400	1400	1400
SELENIUM				
4 DAY AVERAGE	5.0	5.0	5.0	5.0
1 HOUR AVERAGE	20	20	20	20
SILVER				
4 DAY AVERAGE	0.12	0.12	0.12	
1 HOUR AVERAGE (5)	4.1	4.1	4.1	4.1
ZINC (5)				
4 DAY AVERAGE	110	110	110	110
1 HOUR AVERAGE	120	120	120	120
INORGANICS				
(MG/L) (3)				
AMMONIA AS N (UN-IONIZED) (6)				
4 DAY AVERAGE	(6a)	(6a)		
1 HOUR AVERAGE	(6b)	(6b)	(6b)	(6b)
CHLORINE (TOTAL RESIDUAL) (7)				
4 DAY AVERAGE	0.011	0.011		
1 HOUR AVERAGE	0.019	0.019	0.2	(8)
HYDROGEN SULFIDE				
(UNDISSOCIATED, MAX. UG/L)				
PHENOL (MAXIMUM)	2.0	2.0	2.0	2.0
	0.01	0.01	0.01	0.01
RADIOLOGICAL				
(MAXIMUM pCi/L)				
GROSS ALPHA (9)	15	15	15	15

PORT NUMBER

31-083

A & L MID WEST AGRICULTURAL LABORATORIES, INC.

13611 "B" Street • Omaha, Nebraska 68144-3693 • Phone: (402) 334-7770

PORT DATE

19/85

ACCOUNT NO.

3613

GROWER

PO 43-84A0-5-259



TO:

UINTA NATIONAL FOREST

88 WEST 100 NORTH

BOX 1428

PROVO UT 84603

SUBMITTED BY:

SOIL ANALYSIS REPORT

(SEE EXPLANATION ON BACK)

LAB NUMBER	ORGANIC MATTER	PHOSPHORUS			POTASSIUM	MAGNESIUM	CALCIUM	SODIUM	pH		HYDROGEN	CATION EXCHANGE CAPACITY	PERCENT BASE SATURATION (COMPUTED)						
		(WEAK BRAY)	(STRONG BRAY)	BICARBONATE					Ca	Mg			Na	SOIL pH	BUFFER INDEX	Ca	Mg	Na	K
PERCENTS	RATE	ppm	RATE	ppm	ppm	ppm	ppm	ppm	ppm	meq/100g	meq/100g	Ca	Mg	Na	K				
12285	0.40L	41	1VL	2VL	39M	6VL	110M	22M	3.9	7.1	0.1	1.0	10.5	5.2	37.6	16.7	0.0		
12286	1.20	56	3VL	4VL	31VL	8VL	30VL	20VL	2.5	6.4	6.4	6.8	1.2	1.0	2.2	94.4	1.3		
12287	1.0L	52	3VL	10L	31L	45VL	200M	16L	6.4	7.1	0.1	1.7	4.7	22.4	59.7	9.0	4.2		
12288	2.8M	82	11L	16L	44VL	26VL	160VL	28VL	2.6	5.5	4.4	20.5	0.5	1.1	3.9	93.9	0.6		

DTPA EXTRACTION

NITRATE	SULFUR	ZINC	MANGANESE	IRON	COPPER	BORON	EXCESS LIME	SOLUBLE SALTS
NO ₃ -N	S	Zn	Mn	Fe	Cu	B	RATE	mmhos/cm
RATE	ppm	RATE	ppm	RATE	ppm	RATE	ppm	RATE
4L	92VL	110H	1VL	1VL	0.2VL	0.4VL	L	0.4L
4L	92VL	120H	1VL	186VL	3.2VL	0.4VL	L	2.5M
6L	94VL	210H	3VL	4VL	26.0VL	0.5L	L	0.8L
4L	92VL	112H	2VL	176VL	0.9M	0.4VL	L	2.0M

COMMENTS:

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

A & L MID WEST AGRICULTURAL LABORATORIES, INC.

Ken Johnson
AL Rev 5.5 R

INTERPRETATION: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), VERY HIGH (VH), AND NONE (N)
 IMMEDIATE NITROGEN RELEASE
 THE RESULTS IN ppm BY

CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM

Zone 5

..... MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P₂O₅
 MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K₂O
 MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) PER ACRE OF SOIL 6-2/3 INCHES DEEP.

A & L MID WEST AGRICULTURAL LABORATORIES, INC.
13611 "B" Street • Omaha, Nebraska 68144 • Phone: 402-334-7770

FEDERAL ID NUMBER 47-0564465



UINTA NATIONAL FOREST
BB WEST 100 NORTH
BOX 1428
PROVO, UT 84603

INVOICE NUMBER B6622

ACCOUNT NUMBER 3613

DATE 9-05-85 PAGE 1

INVOICE

PORT NO.	GROWER OR SUBMITTED BY	NUMBER OF SAMPLES — TYPE OF ANALYSIS	TOTAL COST
231-083	PO 43-84A0-5-259	4 S2/4 S3/4 Nitrate Nitrogen	95.20
		Subtotal	95.20
		Less 25.00% discount	23.80
	Invoice Total		\$71.40

PLEASE PAY FROM THIS INVOICE

THIS

CE BECOMES OVERDUE 10-3-85

BILLING DEPARTMENT

INTEREST WILL BE CHARGED ON OVER DUE BALANCES AT THE MAXIMUM RATE ALLOWABLE BY LAW, PAYABLE TO THE COUNTY OF ISSUE.

INVOICE

013860

UTAH STATE DEPARTMENT OF HEALTH
Office of Administrative Services
Bureau of Finance
P.O. Box 16700
Salt Lake City, Utah 84116-0700

U.S. DEPARTMENT OF AGRICULTURE
NATIONAL FINANCE CENTER
PO BOX 60075
NEW ORLEANS LOUISIANA 70160

Date: September 1, 1988

Reference:

QUANTITY	DESCRIPTION	PRICE	AMOUNT
	LABORATORY TESTS PERFORMED:		
7 ea.	Water-SO ₄ , T HDNS, T ALK, TDS, Metals	\$95.00	\$665.00
1 ea.	Water-SO ₄ , T HDNS, As, Pb, T ALK, TDS, Cd, Zn	65.00	65.00
1 ea.	Water-T ALK, As, Cu, Hg, TDS, Cd, Pb, Zn	75.00	75.00
1 ea.	Water-SO ₄ , T HDNS, As, Cu, Zn, T ALK, TDS, Cd, Pb	75.00	75.00
1 ea.	Water-As, Cd, Cu, Zn, Pb	45.00	45.00
	Laboratory #s 8803932-8803942		
	TOTAL AMOUNT DUE		\$925.00
	PLEASE RETURN DUPLICATE COPY OF INVOICE WITH REMITTANCE.		

2815-2475-A30700

COPY

88/08/22 11:33

Environmental Chemistry

J80 Page

NORTH FORK AMERICAN FORK ABOVE BOG MINE
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site #1

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN FORK ABOVE BOG MINE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803937 Type: 04

Sample Date: 88/07/20 Time: 10:25

Tot. Cations: 41

Tot. Anions: 83 me/l Cations:

Tot. Cations: 124 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.4 Radiochemistry Review:

2.4 Microbiology Review:

Laboratory Analyses

Sulfate 29 mg/l
T. Hardns. 115.1 mg/l
T-Arsenic <1.0 ug/l
T-Cadmium <1 ug/l
T-Copper <20.0 ug/l
T-Lead <5.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

Tot. Alk. 91 mg/l
TDS @ 180C 128 mg/l
T-Barium 0.037 mg/l
T-Chromium <5.0 ug/l
T-Iron 0.16 mg/l
T-Manganese 24.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc 28.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#/]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

Jul 27 0003937

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork above Bog Mine]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][U][N][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][0][2][5]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[1][0].[0]	CO2:	[][][][]
pH:	[][6].[7]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP.COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

CH TRY: [1] TDS, T-AUX, ARDMS, SO₄

NUTRIENTS: [7]

TOTAL METALS: [1] AS, BA, CD, CR, CU, FE, PB, MN, Hg, SE, AG, ZN

FIELD COMMENTS: TAKE FLOW

Jump = .07' width = 3.6' Depth = -3'

88/08/22 11:33

J80 Page

ADIT OF LOWER BOG MINE
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 2

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: ADIT OF LOWER BOG MINE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803945 Type: 04

Sample Date: 88/07/20 Time: 11:35

Tot. Cations:

Anions: me/l Cations:

d total: me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

T-Arsenic 3.0 ug/l

T-Lead 5.0 ug/l

T-Cadmium

T-Zinc

~~13.0~~ ug/l

30.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#2]

]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

JUL 27 00003945

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [ADIT OF LOWER BOG MINE]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][U][W][D][][][][]

DATE: [8][8][0][7][2][0] TIME: [1][1][3][5] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[0][9].[0]	CO2:	[][][][]
pH:	[][5].[2]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

CAN'T DO FROM AN

COUNTRY: [1] TDS, T-ALK, HONS, SO4 - ACIDIFIED BOTTLES

NUTRIENTS: [7]

TOTAL METALS: [1] AS, CD, PB, ZN

FIELD COMMENTS: TAKE FLOW Jump = .02 1.3' = width Depth = .35'

88/08/22 11:33

Environmental Chemistry

JBO Page

NORTH FORK AMERICAN FORK BELOW LOWER BOG MINE
UINTA NATIONAL FOREST
88 W 100 N
PROVO

UT 84603

Site # 3

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN FORK BELOW LOWER BOG MINE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803933 Type: 04

Sample Date: 88/07/20 Time: 11:50

Tot. Cations: 35

T-Anions: 74 me/l Cations:

C Total: 109 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.0 Radiochemistry Review:

2.1 Microbiology Review:

Laboratory Analyses

Sulfate 31 mg/l

T. Hardns. 96.9 mg/l

T-Arsenic 2.5 ug/l

T-Lead <5.0 ug/l

Tot. Alk. 73 mg/l

TDS @ 180C 120 mg/l

T-Cadmium 1 ug/l

T-Zinc 77.0 ug/l

NORTH FORK AMERICAN FORK RIVER ABOVE PACIFIC
UINTA NATIONAL FOREST
88 W 100 N
PROVO

U1 84603

Site #3A

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN FORK RIVER ABOVE PACIFIC

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8803939 Type: 04

Sample Date: 88/07/20 Time: 14:05

Tot. Cations: 42

Tot. Anions: 80 me/l Cations:

and Total: 122 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.5 Radiochemistry Review:

2.4 Microbiology Review:

Laboratory Analyses

Sulfate	18 mg/l	Tot. Alk.	104 mg/l
T. Hardns.	120.9 mg/l	TDS @ 180C	130 mg/l
T-Arsenic	1.0 ug/l	T-Barium	0.044 mg/l
T-Cadmium	<1 ug/l	T-Chromium	<5.0 ug/l
T-Copper	<20.0 ug/l	T-Iron	0.033 mg/l
T-Lead	<5.0 ug/l	T-Manganese	<5.0 ug/l
Mercury	<0.2 ug/l	T-Selenium	<0.5 ug/l
T-Silver	<2.0 ug/l	T-Zinc	<20.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [# 3A

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

11/2003939

MONITORING RUN: [.]

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork River Above Pacific Mine]

COLLECTOR: [P] [A] [U] [L] [] [A] [] [S] [K] [A] [B] [E] [L] [U] [M] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0]
Y Y M M D D

TIME: [1] [4] [0] [5]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[1] [6] [.] [0]	CO2:	[] [] [] [] []
pH:	[] [6] [.] [7]	DEPTH:	[] [] [] [] [.] []
D.O.:	[] [] [.] []	CL RESID.:	[] [.] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [.] [] []
SP. GRAVITY:	[] [.] [] [] []	FLOW (GPM):	[] [] [] [] [] []
TRANSPARENCY:	[] [] [.] []	FLOW (CFS):	[] [] [] [] [] [] [] [.] []

SAMPLE BOTTLES NEEDED

CISTRY: [1] TDS, T-ALIC, HRDWS., SO₄

NUTRIENT: [7]

TOTAL METALS: [1] AS, BA, CD, CR, CU, FE, PI, MN, HG, SE, AG, ZN

FIELD COMMENTS: TAKE FLOW Jump = .10' Width = 5.5' Depth = .5'

88/08/22 11:33

Environmental Chemistry

JBO Page

PACIFIC MINE -MAIN ADIT
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 4

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE -MAIN ADIT

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803947 Type: 04

Sample Date: 88/07/20 Time:

Tot. Cations:

Tot. Anions: me/l Cations:

() Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

T-Arsenic 20.0 ug/l
T-Copper 42.0 ug/l
Mercury <0.2 ug/l

T-Cadmium 13 ug/l
T-Lead 15.0 ug/l
T-Zinc 1600.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#4]

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UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

7783003947

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [PACIFIC MINE - MAIN ADIT]

COLLECTOR: [P][A][V][L][][H][][S][K][A][B][E][L][V][W][D][][][][]

DATE: [9][8][0][7][2][0] TIME: [][][][] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[][7].[0]	CO2:	[][][][]
pH:	[][6].[5]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][][]
SP. COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][][]	FLOW (GPM):	[][][][][][]
TRANSPARENCY:	[][][][]	FLOW (CFS):	[][][][][][][][]

SAMPLE BOTTLES NEEDED

COMMENTS: [2] TDS, T-ALK - CAN'T TAKE FROM AN
ACIDIFIED BOTTLE

NUTRIENT: [7]

TOTAL METALS: [1] AS, CD, CU, PB, HG, ZN

FIELD COMMENTS: TAKE FLOW Jump = 04' width = 1 ft Depth = .15'

88/08/22 11:33

Environmental Chemistry

J80 Page

PACIFIC MINE N.W.PORTAL *Site #5*
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE N.W.PORTAL
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8803943 Type: 04
Sample Date: 88/07/20 Time: 13:00
Tot. Cations:
Tot. Anions: me/l Cations:
and Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

T-Arsenic 2.0 ug/l T-Lead <5.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#5]

2709003943]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [PACIFIC MINE - NW PORTAL]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [K] [A] [B] [E] [L] [U] [W] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0]
Y Y M M D D

TIME: [1] [3] [0] [0]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[8] [0] [.] [0]	CO2:	[] [] [] [] [] []
pH:	[] [] [.] []	DEPTH:	[] [] [] [] [.] []
D.O.:	[] [] [.] []	CL RESID.:	[] [.] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [.] [] []
SP. GRAVITY:	[] [.] [] [] [] []	FLOW (GPM):	[] [] [] [] [.] []
TRANSPARENCY:	[] [] [.] []	FLOW (CFS):	[] [] [] [] [] [] [.] []

SAMPLE BOTTLES NEEDED

COUNTRY: [1] TDS, T-ALK - CAN'T DO FROM AN ACIDIFIED

NUTRIENTS: [7]

TOTAL METALS: [4] AS, PB

FIELD COMMENTS: TAKE FLOW Same as from Mine Portal at sample
Site # 4

PACIFIC MINE CENTER OF TAILINGS
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 6

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE CENTER OF TAILINGS

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8803944 Type: 04

Sample Date: 88/07/20 Time: 13:10

Tot. Cations:

Tot. Anions: me/l Cations:

d total: me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

T-Arsenic 13.0 ug/l

T-Copper 30.0 ug/l

T-Zinc 1000.0 ug/l

T-Cadmium

T-Lead

8 ug/l

175.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: L #6

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UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

L 77003944

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [Pacific Mine - Center of Tailings]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][U][N][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][3][1][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[2][0].[0]	CO2:	[][][][]
pH:	[][6].[7]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

COUNTRY: [1] TDS, T-ALK, HRDNS, SO4 - CAN'T DO FROM AN
ACIDIFIED BOTTLE

NUTRIENT: [7]

TOTAL METALS: [1] - AS, CD, CU, PB, ZN

FIELD COMMENTS: TAKE FLOW

88/08/22 11:33

Environmental Chemistry

J80 Page

PACIFIC MINE AT LOWER EDGE OF TAILINGS
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site #7

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE AT LOWER EDGE OF TAILINGS

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803946 Type: 04

Sample Date: 88/07/20 Time: 14:25

Tot. Cations:

Anions: me/l Cations:

d Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

T-Arsenic 22.0 ug/l

T-Copper 30.0 ug/l

Mercury 0.29 ug/l

T-Cadmium 9 ug/l

T-Lead 850.0 ug/l

T-Zinc 1000.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#7 2700003946]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [PACIFIC MINE AT LOWER EDGE OF TAILINGS]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [K] [A] [B] [E] [L] [U] [W] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0]
Y Y M M D D

TIME: [1] [4] [2] [5]

TYPE: [] []

FIELD TESTS

TEMPERATURE:

[2] [0] [.] [0]

CO2:

[] [] [] [] []

PH:

[] [6] [.] [7]

DEPTH:

[] [] [] [] [.] []

D.O.:

[] [] [.] []

C1 RESID.:

[] [.] [] []

SP. COND.:

[] [] [] [] [] [] [] []

FLOW (MGD):

[] [.] [] [] []

SP. GRAVITY:

[] [.] [] [] [] []

FLOW (GPM):

[] [] [] [] [.] []

TRANSPARENCY:

[] [] [.] []

FLOW (CFS): [] [] [] [] [] [] [.] []

SAMPLE BOTTLES NEEDED

CHEMISTRY: [1] TDS, FAUK - C.A.W. + TAKE DO FROM AN
ACIDED BOTTLE

NUTRIENT: [7]

TOTAL METALS: [1] AS, CD, CU, PB, HG, ZN

FIELD COMMENTS: TAKE FLOW Jump = .03' Depth = .15' Width = 2.75'

88/08/22 11:33

Environmental Chemistry

JBO Page

NORTH FORK AMERICAN RIVER BELOW PACIFIC MINE
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 8

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN RIVER BELOW PACIFIC MINE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803934 Type: 04

Sample Date: 88/07/20 Time: 14:50

Total Cations:

Total Anions: 69 me/l Cations:

Total: 69 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

Radiochemistry Review:

2.3 Microbiology Review:

Laboratory Analyses

Total Alk. 115 mg/l

Total Arsenic 4.5 ug/l

Total Copper <20.0 ug/l

Mercury <0.2 ug/l

TDS @ 180C

134 mg/l

Total Cadmium

<1 ug/l

Total Lead

20.0 ug/l

Total Zinc

81.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#8]

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UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

1-770-003934

MONITORING RUN: []

SIURET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork River Below Pacific Mine]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][U][N][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][4][5][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[1][7].[0]	CO2:	[][][][]
pH:	[][6].[9]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

CISTRY: [P] TDS, TALK

NUTRIENTS: [7]

TOTAL METALS: [P] AS, CD, CU, PB, HG, ZN

FIELD COMMENTS: TAKE FLOW Jump = .04' Depth = .5' Width = 6 ft'
Site Located Just upstream from Mouth of Dry Fork

88/08/22 11:33

Environmental Chemistry

JBO Page

NORTH FORK AMERICAN FORK RIVER @ DUTCHMAN FLA
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 9

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN FORK RIVER @ DUTCHMAN FLA

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803941 Type: 04

Sample Date: 88/07/20 Time: 15:35

Tot. Cations: 54

Tot. Anions: 101 me/l Cations:

Tot. Total: 155 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

3.2 Radiochemistry Review:

3.2 Microbiology Review:

Laboratory Analyses

Sulfate 16 mg/l
T. Hardns. 157.3 mg/l
T-Arsenic <1.0 ug/l
T-Cadmium <1 ug/l
T-Copper <20.0 ug/l
T-Lead 5.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

Tot. Alk. 143 mg/l
TDS @ 180C 174 mg/l
T-Barium 0.053 mg/l
T-Chromium <5.0 ug/l
T-Iron 0.029 mg/l
T-Manganese 7.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc 43.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#9

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

Jun 27 88 003941

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork River @ Dutchman Flat]

COLLECTOR: [P][A][W][L][][H][][S][K][A][B][G][L][U][M][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][5][3][5]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[][6].[5]	CO2:	[][][][]
pH:	[][6].[8]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

COUNTRY: [1] TDS, T-ALK, NR DNS, SOY

NUTRIENTS: [7]

TOTAL METALS: [1] AS, BA, CD, CR, CU, ~~FE~~, FE, PB, ~~MA~~

W, H, SE, AG, Z

FIELD COMMENTS: TAKE FLOW Jump = .15' Width = 8' Depth = .67'

88708/22 11:33

Environmental Chemistry

JBO Page

MARY ELLEN GULCH CREEK AT MOUTH
UINTA NATIONAL FOREST
88 W 100 N
PROVO

UT 84603

Site # 10

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN GULCH CREEK AT MOUTH

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803940 Type: 04

Sample Date: 88/07/20 Time: 16:10

Tot. Cations: 48

Tot. Anions: 98 me/l Cations:

Tot. Total: 146 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.8 Radiochemistry Review:

2.9 Microbiology Review:

Laboratory Analyses

Sulfate 33 mg/l
T. Hardns. 135.8 mg/l
T-Arsenic 2.5 ug/l
T-Cadmium <1 ug/l
T-Copper <20.0 ug/l
T-Lead <5.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

Tot. Alk. 109 mg/l
TDS @ 180C 154 mg/l
T-Barium 0.046 mg/l
T-Chromium <5.0 ug/l
T-Iron 0.059 mg/l
T-Manganese 6.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc 72.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#10]

003940

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARY ELLEN GULCH CREEK AT MOUTH]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][U][W][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][6][1][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[1][5].[0]	CO2:	[][][][][]
pH:	[][4].[8]	DEPTH:	[][][][][][]
D.O.:	[][][]	CL RESID.:	[][][][]
SP.COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][][]	FLOW (GPM):	[][][][][][]
TRANSPARENCY:	[][][][]	FLOW (CFS):	[][][][][][][][]

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [1] TDS, ALK, THONS., SO₄

NUTRIENT: [7]

TOTAL METALS: [1] AS, BA, CD, CR, CU, FE, PB, MN, HG, SE, AG, ZN

FIELD COMMENTS: TAKE FLOW Jump = 14' width = 3.2' Depth = .18'

88/08/22 11:33

Environmental Chemistry

JBO Page

NORTH FORK AMERICAN FORK BELOW MARY ELLEN GUL
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 11

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN FORK BELOW MARY ELLEN GUL

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8803936 Type: 04

Sample Date: 88/07/20 Time: 16:30

Tot. Cations: 52

Tot. Anions: 101 me/l Cations:

Total: 153 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

3.1 Radiochemistry Review:

3.1 Microbiology Review:

Laboratory Analyses

Sulfate 20 mg/l
T-Hardns. 150.7 mg/l
T-Arsenic 3.5 ug/l
T-Cadmium <1 ug/l
T-Copper <20.0 ug/l
T-Lead 10.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

Tot. Alk. 135 mg/l
TDS @ 180C 158 mg/l
T-Barium 0.053 mg/l
T-Chromium <5.0 ug/l
T-Iron 0.039 mg/l
T-Manganese 7.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc 40.0 ug/l

R-DATE/SAMPLE-NUMBER.: [# 11

01 "

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

Jul 27 85 003936

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork below Mary Ellen Gulch]

COLLECTOR: [P][A][V][L][][H][][S][A][A][B][E][L][U][N][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][6][3][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[1][7].[0]	CO2:	[][][][]
pH:	[][6].[9]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

COUNTRY: [] TDS, T-ALIK, SO₄-HRONS

NUTRIENT: []

TOTAL METALS: [] AS, BA, CD, CR, CU, FE, PB, MN, Hg, SE, AG, ZN

FIELD COMMENTS: TAKE FLOW Jump = .03' Depth = .625' Width = 7'

88/08/22 11:33

Environmental Chemistry

JBO Page

MARY ELLEN GULCH CREEK ABOVE MINE TAILINGS
UINIA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site #12

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN GULCH CREEK ABOVE MINE TAILINGS

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803938 Type: 04

Sample Date: 88/07/21 Time: 09:40

Tot. Cations: 39

Tot. Anions: 77 me/l Cations:

nd Total: 116 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.3 Radiochemistry Review:

2.3 Microbiology Review:

Laboratory Analyses

Sulfate 22 mg/l
T. Hardns. 110.1 mg/l
T-Arsenic 1.5 ug/l
T-Cadmium <1 ug/l
T-Copper <20.0 ug/l
T-Lead <5.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

Tot. Alk. 92 mg/l
TDS @ 180C 120 mg/l
T-Barium 0.041 mg/l
T-Chromium <5.0 ug/l
T-Iron 0.025 mg/l
T-Manganese <5.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc <20.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: #12

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

003938

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARVELLEN GULCH CREEK ABOVE MINE TAILINGS]

COLLECTOR: [P][A][V][L][][H][][S][K][A][B][E][L][V][N][D][][][]

DATE: [8][8][0][7][2][]
Y Y M M D D

TIME: [0][9][4][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:

[][9].[0]

CO2:

[][][][]

pH:

[][6].[7]

DEPTH:

[][][][][]

D.O.:

[][][]

CL RESID.:

[][][][]

SP. COND.:

[][][][][][]

FLOW (MGD):

[][][][]

SP. GRAVITY:

[][][][][]

FLOW (GPM):

[][][][][][]

TRANSPARENCY:

[][][]

FLOW (CFS):

[][][][][][][][]

SAMPLE BOTTLES NEEDED

CHEMISTRY: [1] TDS, T-ALK, HRDNS, SO4

NUTRIENTS: [7]

TOTAL METALS: [1] AS, BA, CD, CR, CU, FE, PB, MN, Hg, SE, AG, ZN

FIELD COMMENTS: TAKE FLOW Dump = .02' Width = 1.5' Depth = .13'

88/08/22 11:33

Environmental Chemistry

JBO Pag

MARY ELLEN MINE PORTAL
UINTA NATIONAL FOREST
88 W 100 N
PROVO

Site # 13

UT 84603

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN MINE PORTAL
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8803942 Type: 04
Sample Date: 88/07/21 Time: 10:00
Tot. Cations:
Tot. Anions: me/l Cations:
nd total: me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

T-Arsenic 97.0 ug/l
T-Copper <20.0 ug/l
T-Zinc 570.0 ug/l

T-Cadmium 1 ug/l
T-Lead <5.0 ug/l

01

R-DATE/SAMPLE-NUMBER.: [#13 770003942

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MONITORING RUN: []

SICRET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARY ~~ELLEN~~ ELLEN MINE PORTAL]

COLLECTOR: [P][A][V][L][][H][][S][A][A][B][G][L][U][N][D][][][][]

DATE: [8][8][0][7][2][1]
Y Y M M D D

TIME: [1][0][0][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[][7].[0]	CO2:	[][][][]
pH:	[][6].[5]	DEPTH:	[][][][][]
D.O.:	[][][]	Cl RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

CHEMISTRY: [1] TDS, T-ALK, HARDNESS, ~~2~~ 54 - CAN'T DO FROM AN
ACTIVATED BOTTLE

NUTRIENT: [7]

TOTAL METALS: [7] AS, CD, CU, PB, ZN

FIELD COMMENTS: TAKE FLOW Jump = .03' Width = 1.0' Depth = .21'

88/08/22 11:33

Environmental Chemistry

JBO Page

WEST FORK MARY ELLEN GULCH CREEK @ MOUTH
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site # 13A

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: WEST FORK MARY ELLEN GULCH CREEK @ MOUTH

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803932 Type: 04

Sample Date: 88/07/21 Time: 11:00

Tot. Cations: 43

Tot. Anions: 103 me/l Cations:

Total: 146 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.5 Radiochemistry Review:

2.6 Microbiology Review:

Laboratory Analyses

Sulfate	67 mg/l
T. Hardns.	121.7 mg/l
T-Arsenic	14.5 ug/l
T-Cadmium	2 ug/l
T-Copper	53.0 ug/l
T-Lead	10.0 ug/l
Mercury	<0.2 ug/l
T-Silver	<2.0 ug/l

Tot. Alk.	60 mg/l
TDS @ 180C	190 mg/l
T-Barium	0.022 mg/l
T-Chromium	<5.0 ug/l
T-Iron	1.2 mg/l
T-Manganese	74.0 ug/l
T-Selenium	<0.5 ug/l
T-Zinc	450.0 ug/l

R-DATE/SAMPLE-NUMBER.: [#13A]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

10770003932

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [West Fork Mary Ellen Gulch Creek @ Mouth]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][][L][U][N][D][][][][]

DATE: [8][8][0][7][2][1] TIME: [1][1][0][0] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[1][3].[0]	CO2:	[][][][]
pH:	[][6].[7]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

CHTRY: [8]1-T-ALK, HRONS, SO4, TDS

NUTRIENT: [8]

TOTAL METALS: [8]1-As, BA, CO, CR, CU, FE, PB, MN, Hg, SE, AG, ZN

FIELD COMMENTS: TAKE FLOW Jump = .07' Width = 1.5' Depth = .3'

88/08/22 11:33

Environmental Chemistry

JBO Pag

MARY ELLEN GULCH CREEK BELOW MINE TAILINGS
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

Site #14

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN GULCH CREEK BELOW MINE TAILINGS

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803935 Type: 04

Sample Date: 88/07/21 Time: 11:35

Tot. Cations: 48

Tot. Anions: 98 me/l Cations:

G Total: 146 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.8 Radiochemistry Review:

2.8 Microbiology Review:

Laboratory Analyses

Sulfate 38 mg/l

T. Hardns. 137.4 mg/l

T-Arsenic 3.0 ug/l

T-Copper <20.0 ug/l

T-Zinc 110.0 ug/l

Tot. Alk. 100 mg/l

TDS @ 180C 138 mg/l

T-Cadmium <1 ug/l

T-Lead <5.0 ug/l

R-DATE/SAMPLE-NUMBER.: [#14

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

4-770003935

MONITORING RUN: []

STOKET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARY ELLEN GULCH CR. BELOW MINE TAILINGS

COLLECTOR: [P][A][U][L][][H][][S][A][A][B][E][L][U][N][D][][][][]

DATE: [8][8][0][7][2][1]
Y Y M M D D

TIME: [1][1][3][5]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[/][3].[5]	CO2:	[][][][]
pH:	[][6].[7]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][][]	FLOW (MGD):	[][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][]

SAMPLE BOTTLES NEEDED

CHL TRY: [1] TDS, T-ALIS, HRDWS, SO₄

NUTRIENT: [7]

TOTAL METALS: [1] AS, CD, CU, PB, ZN

FIELD COMMENTS: TAKE FLOW Jump = .04 Width = 3.0' Depth = .43

88/06/10 13:41

Environmental Chemistry

JBO Page:

PACIFIC MINE MAIN PORTAL AT ADIT
 UINIA NATIONAL FOREST
 88 W 100 N
 PROVO UT 84603

377-5780

UTAH STATE HEALTH LABORATORY
 Environmental Chemistry Analysis Report

Description: PACIFIC MINE MAIN PORTAL AT ADIT

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802854 Type: 04

Sample Date: 88/05/18 Time: 10:00

Tot. Cations:

Tot. Anions: me/l Cations:

Tot. Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk.	163 mg/l	TDS @ 180C	202 mg/l
I-Arsenic	22.0 ug/l	I-Barium	0.069 mg/l
I-Cadmium	6 ug/l	I-Chromium	<5.0 ug/l
I-Copper	34.0 ug/l	I-Iron	4.0 mg/l
I-Lead	25.0 ug/l	I-Manganese	11.0 ug/l
Mercury	0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	800.0 ug/l

UINIA
 NATIONAL FOREST

SEP 26 1988

TO	ACT	TO	ACT
IS		CLP	
SECY		PRO	
AO		CS	
ENG		RES	
PLS		STATION	
MM		FIREMAN	
YIMOSH		FIRE STAFF	
CHI		2	
CO			
DO			

UTAH STATE HEALTH LABORATORY

2354

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 8-5-19 Time Collected 10:00
yy/mm/dd 24 hr clockExact Description of Sampling Point: PACIFIC MINE MAIN PORTAL
A+ ADITCollector: PAUL H. SKABELUND County: _____ Cost Code: 3503Send Report to: UINTA NAT. FOREST Telephone No: 377-5780Address: 88W 100N PROVO, UTAH Zip: 846031 TC PC / TH PM BOD Nut Bact Pest THM Rad Spec

<u> </u> BOD	<u> </u> Cyanide	<u> </u> MPN Total Coliforms/100 ml
<u> </u> TSS	<u> </u> Phenolics	<u> </u> MPN Fecal Coliforms/100 ml
<u> </u> TKN	<u> </u> Sulfide	<u> </u> MF Total Coliforms/100 ml
<u> </u> TOC	<u> </u> pH	<u> </u> MF Fecal Coliforms/100 ml
<u> </u> COD	<u> </u> Oil & Grease	<u> </u> Fecal Streptococci/100 ml
		<u> </u> Plate Count - Org./ml

CATIONS		ANIONS	TOTAL METALS	
<u> </u> Ammonia	<u> </u> Lead	<u> </u> Bicarbonate	<u> </u> Aluminum	<u>X</u> Lead
<u> </u> Arsenic	<u> </u> Magnesium	<u> </u> Carbon Dioxide	<u>X</u> Arsenic	<u>X</u> Manganese
<u> </u> Barium	<u> </u> Manganese	<u> </u> Carbonate	<u>X</u> Barium	<u>X</u> Mercury
<u> </u> Boron	<u> </u> Nickel	<u> </u> Chloride	<u> </u> Beryllium	<u> </u> Molybdenum
<u> </u> Cadmium	<u> </u> Potassium	<u> </u> CO ₃ Solids	<u>X</u> Cadmium	<u> </u> Nickel
<u> </u> Calcium	<u> </u> Selenium	<u> </u> Fluoride	<u>X</u> Chromium	<u>X</u> Selenium
<u> </u> Chromium	<u> </u> Silver	<u> </u> Hydroxide	<u> </u> Cobalt	<u>X</u> Silver
<u> </u> Chromium, Hex	<u> </u> Sodium	<u> </u> Nitrate	<u>X</u> Copper	<u> </u> Vanadium
<u> </u> Copper	<u> </u> Zinc	<u> </u> Nitrite	<u>X</u> Iron	<u>X</u> Zinc
<u> </u> Iron		<u> </u> Phosphorus, Ortho		
		<u> </u> Silica		
		<u> </u> Sulfate		

 Total Phosphorus
X Total Alk. as CaCO₃
 Total Hardness as CaCO₃
 Turbidity as NTU
 Sp. Cond. (umhos/cm)
X TDS @ 180°C
 Other: _____

RADIOLOGICS

<u> </u> Alpha, Gross	<u> </u> ²²⁸ Radium
<u> </u> Beta, Gross	<u> </u> Uranium
<u> </u> ²²⁶ Radium	

NORTH FORK AMERICAN RIVER AT DUTCHMAN FLAT
UNITA NATIONAL FOREST

88 W 100 N

PROVO

UT

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN RIVER AT DUTCHMAN FLAT

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802855 Type: 04

Sample Date: 88/05/18 Time: 16:10

Tot. Cations:

Tot. Anions:

and Total:

me/l Cations:

me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk.	83 mg/l	TDS @ 180C	102 mg/l
l-Arsenic	2.5 ug/l	l-Barium	0.056 mg/l
l-Cadmium	<1 ug/l	l-Chromium	<5.0 ug/l
l-Copper	<20.0 ug/l	l-Iron	0.45 mg/l
l-Lead	60.0 ug/l	l-Manganese	31.0 ug/l
Mercury	<0.2 ug/l	l-Selenium	<0.5 ug/l
l-Silver	<2.0 ug/l	l-Zinc	77.0 ug/l

UTAH STATE HEALTH LABORATORY

7-7-10 02855

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 08-5-18 Time Collected 16.10
yy/mm/dd 24 hr clockExact Description of Sampling Point: NORTH FORK AMERICAN FORK
RIVER AT DUTCHMAN FLATCollector: PAUL H. SKABELUND County: _____ Cost Code: 3508Send Report to: UINTA NAT. FOREST Telephone No: 377-5780Address: 88W 100N PROVO, UTAH Zip: 846031 TC PC / TH PM BOD Nut Bact Pest THM Rad Spec BOD
 TSS
 TKN
 TOC
 COD
 Cyanide
 Phenolics
 Sulfide
 pH
 Oil & Grease MPN Total Coliforms/100 ml
 MPN Fecal Coliforms/100 ml
 MF Total Coliforms/100 ml
 MF Fecal Coliforms/100 ml
 Fecal Streptococci/100 ml
 Plate Count - Org./ml

CATIONS

 Ammonia
 Arsenic
 Barium
 Boron
 Cadmium
 Calcium
 Chromium
 Chromium, Hex
 Copper
 Iron
 Lead
 Magnesium
 Manganese
 Nickel
 Potassium
 Selenium
 Silver
 Sodium
 Zinc

ANIONS

 Bicarbonate
 Carbon Dioxide
 Carbonate
 Chloride
 CO₃ Solids
 Fluoride
 Hydroxide
 Nitrate
 Nitrite
 Phosphorus, Ortho
 Silica
 Sulfate

TOTAL METALS

 Aluminum
X Arsenic
X Barium
 Beryllium
X Cadmium
X Chromium
 Cobalt
X Copper
X Iron
X Lead
X Manganese
X Mercury
 Molybdenum
 Nickel
X Selenium
 Silver
 Vanadium
X Zinc Total Phosphorus
X Total Alk. as CaCO₃
 Total Hardness as CaCO₃
 Turbidity as NTU
 Sp. Cond. (umhos/cm)
X TDS @ 180°C
 Other: _____

RADIOLOGICS

 Alpha, Gross
 Beta, Gross
 ²²⁶Radium
 ²²⁸Radium
 Uranium

PAC.MINE NW PORTAL PIPED OUT OF MINE
UINTA NATIONAL FOREST

88 W 100 N

PROVO

UT

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PAC.MINE NW PORTAL PIPED OUT OF MINE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802856 Type: 04

Sample Date: 88/05/18 Time: 10:10

Tot. Cations:

Tot. Anions: me/l Cations:

nd Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk.	198 mg/l	TDS @ 180C	208 mg/l
I-Arsenic	1.0 ug/l	I-Barium	0.15 mg/l
I-Cadmium	<1 ug/l	I-Chromium	<5.0 ug/l
I-Copper	<20.0 ug/l	I-Iron	0.091 mg/l
I-Lead	60.0 ug/l	I-Manganese	19.0 ug/l
Mercury	<0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	78.0 ug/l

UTAH STATE HEALTH LABORATORY

2856

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 88 5/8 Time Collected 10:10
yy/mm/dd 24 hr clockExact Description of Sampling Point: PAC. MINE NW PORTAL
PIPED OUT OF MINECollector: PAUL H. SKABELUND County: _____ Cost Code: 3503Send Report to: UINTA NATIONAL FOREST Telephone No: 377-5780Address: 88 W 100 N PROVO, UTAH Zip: 846031 TC PC 1 TM PH BOD Nut Bact Pest THM Rad Spec

<u> </u> BOD	<u> </u> Cyanide	<u> </u> MPN Total Coliforms/100 ml
<u> </u> TSS	<u> </u> Phenolics	<u> </u> MPN Fecal Coliforms/100 ml
<u> </u> TKN	<u> </u> Sulfide	<u> </u> MF Total Coliforms/100 ml
<u> </u> TOC	<u> </u> pH	<u> </u> MF Fecal Coliforms/100 ml
<u> </u> COD	<u> </u> Oil & Grease	<u> </u> Fecal Streptococci/100 ml
		<u> </u> Plate Count - Org./ml

CATIONS

<u> </u> Ammonia	<u> </u> Lead
<u> </u> Arsenic	<u> </u> Magnesium
<u> </u> Barium	<u> </u> Manganese
<u> </u> Boron	<u> </u> Nickel
<u> </u> Cadmium	<u> </u> Potassium
<u> </u> Calcium	<u> </u> Selenium
<u> </u> Chromium	<u> </u> Silver
<u> </u> Chromium, Hex	<u> </u> Sodium
<u> </u> Copper	<u> </u> Zinc
<u> </u> Iron	

ANIONS

<u> </u> Bicarbonate
<u> </u> Carbon Dioxide
<u> </u> Carbonate
<u> </u> Chloride
<u> </u> CO ₃ Solids
<u> </u> Fluoride
<u> </u> Hydroxide
<u> </u> Nitrate
<u> </u> Nitrite
<u> </u> Phosphorus, Ortho
<u> </u> Silica
<u> </u> Sulfate

TOTAL METALS

<u> </u> Aluminum	<u> </u> <input checked="" type="checkbox"/> Lead
<u> </u> <input checked="" type="checkbox"/> Arsenic	<u> </u> <input checked="" type="checkbox"/> Manganese
<u> </u> <input checked="" type="checkbox"/> Barium	<u> </u> <input checked="" type="checkbox"/> Mercury
<u> </u> Beryllium	<u> </u> Molybdenum
<u> </u> <input checked="" type="checkbox"/> Cadmium	<u> </u> Nickel
<u> </u> <input checked="" type="checkbox"/> Chromium	<u> </u> <input checked="" type="checkbox"/> Selenium
<u> </u> Cobalt	<u> </u> <input checked="" type="checkbox"/> Silver
<u> </u> <input checked="" type="checkbox"/> Copper	<u> </u> Vanadium
<u> </u> Iron	<u> </u> <input checked="" type="checkbox"/> Zinc

<u> </u> Total Phosphorus
<u> </u> <input checked="" type="checkbox"/> Total Alk. as CaCO ₃
<u> </u> Total Hardness as CaCO ₃
<u> </u> Turbidity as NTU
<u> </u> Sp. Cond. (umhos/cm)
<u> </u> <input checked="" type="checkbox"/> TDS @ 180°C
<u> </u> Other: _____

RADIOLOGICS

<u> </u> Alpha, Gross	<u> </u> ²²⁸ Radium
<u> </u> Beta, Gross	<u> </u> Uranium
<u> </u> ²²⁶ Radium	

PORTAL LOWER BOG MINE
UNION NATIONAL FOREST
88 W 100 N
PROVO

UT 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PORTAL LOWER BOG MINE
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802857 Type: 04
Sample Date: 88/05/18 Time: 12:30
Tot. Cations:
Tot. Anions: me/l Cations:
Cond Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk. 0 mg/l
I-Arsenic 1.5 ug/l
I-Cadmium 12 ug/l
I-Copper <20.0 ug/l
I-Lead <5.0 ug/l
Mercury <0.2 ug/l
I-Silver <2.0 ug/l

TDS @ 180C 90 mg/l
I-Barium 0.037 mg/l
I-Chromium <5.0 ug/l
I-Iron 7.9 mg/l
I-Manganese 270.0 ug/l
I-Selenium <0.5 ug/l
I-Zinc 510.0 ug/l

UTAH STATE HEALTH LABORATORY

Environmental Chemistry Water Analysis

12857

Water System No. _____ Source No. _____ Date Collected 08-5-18 Time Collected 12:30
yy/mm/dd 24 hr clockExact Description of Sampling Point: PORTAL LOWER BOG MINECollector: PAUL H. SKABELUND County: _____ Cost Code: 35013Send Report to: UINTA NATIONAL FOREST Telephone No: 377-5780Address: 88W 100N PROVO, UTAH Zip: 846031 TC PC / TH PH BOD Nut Bact Pest THM Rad Spec BOD
 TSS
 TKN
 TOC
 COD
 Cyanide
 Phenolics
 Sulfide
 pH
 Oil & Grease MPN Total Coliforms/100 ml
 MPN Fecal Coliforms/100 ml
 MF Total Coliforms/100 ml
 MF Fecal Coliforms/100 ml
 Fecal Streptococci/100 ml
 Plate Count - Org./ml

CATIONS

 Ammonia
 Arsenic
 Barium
 Boron
 Cadmium
 Calcium
 Chromium
 Chromium, Hex
 Copper
 Iron
 Lead
 Magnesium
 Manganese
 Nickel
 Potassium
 Selenium
 Silver
 Sodium
 Zinc

ANIONS

 Bicarbonate
 Carbon Dioxide
 Carbonate
 Chloride
 CO₃ Solids
 Fluoride
 Hydroxide
 Nitrate
 Nitrite
 Phosphorus, Ortho
 Silica
 Sulfate

TOTAL METALS

 Aluminum
X Arsenic
X Barium
 Beryllium
X Cadmium
X Chromium
 Cobalt
X Copper
X Iron
X Lead
X Manganese
X Mercury
 Molybdenum
 Nickel
X Selenium
X Silver
 Vanadium
X Zinc Total Phosphorus
X Total Alk. as CaCO₃
 Total Hardness as CaCO₃
 Turbidity as NTU
 Sp. Cond. (umhos/cm)
X TDS @ 180°C
 Other: _____

RADIOLOGICS

 Alpha, Gross
 Beta, Gross
 ²²⁶Radium
 ²²⁸Radium
 Uranium

MARY ELLEN PORTAL
UINTA NATIONAL FOREST
88 W 100 N
PROVO

U1 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN PORTAL
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802858 Type: 04
Sample Date: 88/05/16 Time: 15:00
Tot. Cations:
Tot. Anions: me/l Cations:
and Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

Tot. Alk.	36 mg/l	TDS @ 180C	206 mg/l
I-Arsenic	100.0 ug/l	I-Barium	0.019 mg/l
I-Cadmium	4 ug/l	I-Chromium	<5.0 ug/l
I-Copper	40.0 ug/l	I-Iron	9.9 mg/l
I-Lead	10.0 ug/l	I-Manganese	140.0 ug/l
Mercury	<0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	1200.0 ug/l

UTAH STATE HEALTH LABORATORY

107-111 2858

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 8-8-5-16 Time Collected 15:00
yy/mm/dd 24 hr clockExact Description of Sampling Point: MARY ELLEN PORTALCollector: PAUL H. SKABELUND County: _____ Cost Code: 350BSend Report to: WINTA NATIONAL FOREST Telephone No: 377-5780Address: 8.8 W 100 N PROVO, UTAH Zip: 846031 TC PC 1 TH PM BOD Nut Bact Pest THM Rad Spec

<u> </u> BOD	<u> </u> Cyanide	<u> </u> MPN Total Coliforms/100 ml
<u> </u> TSS	<u> </u> Phenolics	<u> </u> MPN Fecal Coliforms/100 ml
<u> </u> TKN	<u> </u> Sulfide	<u> </u> MF Total Coliforms/100 ml
<u> </u> TOC	<u> </u> pH	<u> </u> MF Fecal Coliforms/100 ml
<u> </u> COD	<u> </u> Oil & Grease	<u> </u> Fecal Streptococci/100 ml
		<u> </u> Plate Count - Org./ml

CATIONS		ANIONS		TOTAL METALS	
<u> </u> Ammonia	<u> </u> Lead	<u> </u> Bicarbonate	<u> </u> X Aluminum	<u> </u> X Lead	
<u> </u> Arsenic	<u> </u> Magnesium	<u> </u> Carbon Dioxide	<u> </u> X Arsenic	<u> </u> X Manganese	
<u> </u> Barium	<u> </u> Manganese	<u> </u> Carbonate	<u> </u> X Barium	<u> </u> X Mercury	
<u> </u> Boron	<u> </u> Nickel	<u> </u> Chloride	<u> </u> X Beryllium	<u> </u> Molybdenum	
<u> </u> Cadmium	<u> </u> Potassium	<u> </u> CO ₃ Solids	<u> </u> X Cadmium	<u> </u> Nickel	
<u> </u> Calcium	<u> </u> Selenium	<u> </u> Fluoride	<u> </u> X Chromium	<u> </u> X Selenium	
<u> </u> Chromium	<u> </u> Silver	<u> </u> Hydroxide	<u> </u> Cobalt	<u> </u> X Silver	
<u> </u> Chromium, Hex	<u> </u> Sodium	<u> </u> Nitrate	<u> </u> X Copper	<u> </u> Vanadium	
<u> </u> Copper	<u> </u> Zinc	<u> </u> Nitrite	<u> </u> X Iron	<u> </u> X Zinc	
<u> </u> Iron		<u> </u> Phosphorus, Ortho			
		<u> </u> Silica			
		<u> </u> Sulfate			

 Total Phosphorus
X Total Alk. as CaCO₃
 Total Hardness as CaCO₃
 Turbidity as NTU
 Sp. Cond. (umhos/cm)
X TDS @ 180°C
 Other: _____

RADIOLOGICS

 Alpha, Gross ²²⁸Radium
 Beta, Gross Uranium
 ²²⁶Radium

PACIFIC PORTAL AT CREEK (MARKINGS WIPED OFF)
UINTA NATIONAL FOREST

88 W 100 N

PROVO

U1

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC PORTAL AT CREEK (MARKINGS WIPED OFF)

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8802859 Type: 04

Sample Date: Time:

Total Cations:

Total Anions:

Total:

me/l Cations:

me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Total Alk.	164 mg/l	TDS @ 180C	200 mg/l
Total Arsenic	22.5 ug/l	Total Barium	0.28 mg/l
Total Cadmium	31 ug/l	Total Chromium	<5.0 ug/l
Total Copper	60.0 ug/l	Total Iron	5.3 mg/l
Total Lead	4000.0 ug/l	Total Manganese	23.0 ug/l
Mercury	0.63 ug/l	Total Selenium	<0.5 ug/l
Total Silver	5.0 ug/l	Total Zinc	1600.0 ug/l

UTAH STATE HEALTH LABORATORY

2859

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 08-5- Time Collected _____
yy/mm/dd 24 hr clockExact Description of Sampling Point: PACIFIC PORTAL AT CREEKCollector: PAUL H. SKABELUND County: _____ Cost Code: 3503Send Report to: UNITA NATIONAL FOREST Telephone No: 377-5780Address: P.O. BOX 10001 PROVO, UTAH Zip: 846031 TC 1 PC 1 TH 1 PM 1 BOD 1 Nut 1 Bact 1 Pest 1 THM 1 Rad 1 Spec

<u>1</u> BOD	<u>1</u> Cyanide	<u>1</u> MPN Total Coliforms/100 ml
<u>1</u> TSS	<u>1</u> Phenolics	<u>1</u> MPN Fecal Coliforms/100 ml
<u>1</u> TKN	<u>1</u> Sulfide	<u>1</u> MF Total Coliforms/100 ml
<u>1</u> TOC	<u>1</u> pH	<u>1</u> MF Fecal Coliforms/100 ml
<u>1</u> COD	<u>1</u> Oil & Grease	<u>1</u> Fecal Streptococci/100 ml
		<u>1</u> Plate Count - Org./ml

CATIONS		ANIONS		TOTAL METALS	
<u>1</u> Ammonia	<u>1</u> Lead	<u>1</u> Bicarbonate	<u>1</u> Aluminum	<u>1</u> Lead	
<u>1</u> Arsenic	<u>1</u> Magnesium	<u>1</u> Carbon Dioxide	<u>1</u> Arsenic	<u>1</u> Manganese	
<u>1</u> Barium	<u>1</u> Manganese	<u>1</u> Carbonate	<u>1</u> Barium	<u>1</u> Mercury	
<u>1</u> Boron	<u>1</u> Nickel	<u>1</u> Chloride	<u>1</u> Beryllium	<u>1</u> Molybdenum	
<u>1</u> Cadmium	<u>1</u> Potassium	<u>1</u> CO ₃ Solids	<u>1</u> Cadmium	<u>1</u> Nickel	
<u>1</u> Calcium	<u>1</u> Selenium	<u>1</u> Fluoride	<u>1</u> Chromium	<u>1</u> Selenium	
<u>1</u> Chromium	<u>1</u> Silver	<u>1</u> Hydroxide	<u>1</u> Cobalt	<u>1</u> Silver	
<u>1</u> Chromium, Hex	<u>1</u> Sodium	<u>1</u> Nitrate	<u>1</u> Copper	<u>1</u> Vanadium	
<u>1</u> Copper	<u>1</u> Zinc	<u>1</u> Nitrite	<u>1</u> Iron	<u>1</u> Zinc	
<u>1</u> Iron		<u>1</u> Phosphorus, Ortho			
		<u>1</u> Silica			
		<u>1</u> Sulfate			

<u>1</u> Total Phosphorus	<u>1</u> RADIOLOGICS
<u>1</u> Total Alk. as CaCO ₃	<u>1</u> Alpha, Gross
<u>1</u> Total Hardness as CaCO ₃	<u>1</u> Beta, Gross
<u>1</u> Turbidity as NTU	<u>1</u> 226 Radium
<u>1</u> Sp. Cond. (umhos/cm)	<u>1</u> 228 Radium
<u>1</u> TDS @ 180°C	<u>1</u> Uranium
<u>1</u> Other:	

PACIFIC N TAILING
UINIA NATIONAL FOREST
88 W 100 N
PROVO

U1 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC N TAILING
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802860 Type: 04
Sample Date: 88/05/18 Time:
Tot. Cations:
Tot. Anions: me/l Cations:
Grand Total: me/l Anions:

Date of Review and QA Validation
Inorganic Review:
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

Tot. Alk.	21 mg/l	TDS @ 180C	140 mg/l
P-Arsenic	90.0 ug/l	P-Barium	0.15 mg/l
P-Cadmium	51 ug/l	P-Chromium	<5.0 ug/l
P-Copper	260.0 ug/l	P-Iron	13.0 mg/l
P-Lead	20000.0 ug/l	P-Manganese	48.0 ug/l
Mercury	3.24 ug/l	P-Selenium	1.0 ug/l
P-Silver	45.0 ug/l	P-Zinc	7700.0 ug/l

UTAH STATE HEALTH LABORATORY

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 8-5-78 Time Collected _____
yy/mm/dd 24 hr clock

Exact Description of Sampling Point: PACIFIC N TAILING

Collector: PAUL H. SKABELUND County: _____ Cost Code: 35013

Send Report to: UINHA NATIONAL FOREST Telephone No: 377-5780

Address: 88W-100N PROVO, UTAH Zip: 84603

1 TC 1 PC 1 TH 1 PM 1 BOD 1 Nut 1 Bact 1 Pest 1 THM 1 Rad 1 Spec

1 BOD 1 Cyanide
1 TSS 1 Phenolics
1 TKN 1 Sulfide
1 TOC 1 pH
1 COD 1 Oil & Grease

1 MPN Total Coliforms/100 ml
1 MPN Fecal Coliforms/100 ml
1 MF Total Coliforms/100 ml
1 MF Fecal Coliforms/100 ml
1 Fecal Streptococci/100 ml
1 Plate Count - Org./ml

CATIONS

1 Ammonia 1 Lead
1 Arsenic 1 Magnesium
1 Barium 1 Manganese
1 Boron 1 Nickel
1 Cadmium 1 Potassium
1 Calcium 1 Selenium
1 Chromium 1 Silver
1 Chromium, Hex 1 Sodium
1 Copper 1 Zinc
1 Iron

ANIONS

1 Bicarbonate
1 Carbon Dioxide
1 Carbonate
1 Chloride
1 CO₃ Solids
1 Fluoride
1 Hydroxide
1 Nitrate
1 Nitrite
1 Phosphorus, Ortho
1 Silica
1 Sulfate

TOTAL METALS

1 Aluminum 1 Lead
1 Arsenic 1 Manganese
1 Barium 1 Mercury
1 Beryllium 1 Molybdenum
1 Cadmium 1 Nickel
1 Chromium 1 Selenium
1 Cobalt 1 Silver
1 Copper 1 Vanadium
1 Iron 1 Zinc

1 Total Phosphorus
1 Total Alk. as CaCO₃
1 Total Hardness as CaCO₃
1 Turbidity as NTU
1 Sp. Cond. (umhos/cm)
1 TDS @ 180°C
Other: _____

RADIOLOGICS

1 Alpha, Gross 1 ²²⁸Radium
1 Beta, Gross 1 Uranium
1 ²²⁶Radium

MARY ELLEN CREEK 1/4 MILE BELOW MINE AREA
UINTA NATIONAL FOREST

88 W 100 N

PROVO

UT

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN CREEK 1/4 MILE BELOW MINE AREA

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8802861 Type: 04

Sample Date: 88/05/18 Time:

Date of Review and QA Validation

Inorganic Review: 88/06/22

Organic Review:

Radiochemistry Review:

Tot. Cations: 55 me/l Cations:

Tot. Anions: 55 me/l Anions:

Cond total: 55 me/l Anions: 1.8 Microbiology Review:

Laboratory Analyses

Tot. Alk. 92 mg/l
T-Arsenic <1.0 ug/l
T-Cadmium 2 ug/l
T-Copper 42.0 ug/l
T-Lead 40.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

TDS @ 180C 132 mg/l
T-Barium 0.039 mg/l
T-Chromium <5.0 ug/l
T-Iron 1.1 mg/l
T-Manganese 46.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc 310.0 ug/l

UTAH STATE HEALTH LABORATORY

Environmental Chemistry Water Analysis

11-751002861

Water System No. _____ Source No. _____ Date Collected 88-5-18 Time Collected _____
yy/mm/dd 24 hr clockExact Description of Sampling Point: MARY ELLEN CREEK
1/4 MILE BELOW MINE AREACollector: PAUL H. SKABELUND County: _____ Cost Code: 350BSend Report to: UNITA NATIONAL FOREST Telephone No: 377-5720Address: 88 W 100 N PRIMO, UTAH Zip: 846031 TC 1 PC 1 TH 1 PM 1 BOD 1 Nut 1 Bact 1 Pest 1 THM 1 Rad 1 Spec1 BOD 1 Cyanide
1 TSS 1 Phenolics
1 TKN 1 Sulfide
1 TOC 1 pH
1 COD 1 Oil & Grease1 MPN Total Coliforms/100 ml
1 MPN Fecal Coliforms/100 ml
1 MF Total Coliforms/100 ml
1 MF Fecal Coliforms/100 ml
1 Fecal Streptococci/100 ml
1 Plate Count - Org./ml

CATIONS

1 Ammonia 1 Lead
1 Arsenic 1 Magnesium
1 Barium 1 Manganese
1 Boron 1 Nickel
1 Cadmium 1 Potassium
1 Calcium 1 Selenium
1 Chromium 1 Silver
1 Chromium, Hex 1 Sodium
1 Copper 1 Zinc
1 Iron

ANIONS

1 Bicarbonate
1 Carbon Dioxide
1 Carbonate
1 Chloride
1 CO₃ Solids
1 Fluoride
1 Hydroxide
1 Nitrate
1 Nitrite
1 Phosphorus, Ortho
1 Silica
1 Sulfate

TOTAL METALS

1 Aluminum 1 Lead
1 Arsenic 1 Manganese
1 Barium 1 Mercury
1 Beryllium 1 Molybdenum
1 Cadmium 1 Nickel
1 Chromium 1 Selenium
1 Cobalt 1 Silver
1 Copper 1 Vanadium
1 Iron 1 Zinc1 Total Phosphorus
1 Total Alk. as CaCO₃
1 Total Hardness as CaCO₃
1 Turbidity as NTU
1 Sp. Cond. (umhos/cm)
1 TDS @ 180°C
Other: _____

RADIOLOGICS

1 Alpha, Gross 1 ²²⁸Radium
1 Beta, Gross 1 Uranium
1 ²²⁶Radium

PACIFIC MINE PORTAL FLOW 200 YDS. BELOW PORTA
UINTA NATIONAL FOREST

88 W 100 N

PROVO

UT

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE PORTAL FLOW 200 YDS. BELOW PORTA

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8802862 Type: 04

Sample Date: 88/05/18 Time:

Date of Review and QA Validation

Inorganic Review: 88/06/22

Tot. Cations:

Organic Review:

Tot. Anions: 91 me/l Cations:

Radiochemistry Review:

Cond Total: 91 me/l Anions:

3.0 Microbiology Review:

Laboratory Analyses

Tot. Alk.	152 mg/l	TDS @ 180C	202 mg/l
l-Arsenic	24.0 ug/l	T-Barium	0.11 mg/l
l-Cadmium	9 ug/l	l-Chromium	<5.0 ug/l
l-Copper	62.0 ug/l	T-Iron	6.6 mg/l
l-Lead	180.0 ug/l	l-Manganese	23.0 ug/l
Mercury	<0.2 ug/l	l-Selenium	<0.5 ug/l
l-Silver	<2.0 ug/l	l-Zinc	1300.0 ug/l

UTAH STATE HEALTH LABORATORY

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected _____ Time Collected _____
 yy/mm/dd 24 hr clock

Exact Description of Sampling Point: PACIFIC MINE PORTAL FLOW
200 yds BELOW PORTAL

Collector: PAUL H. SKABELUND County: _____ Cost Code: 35013

Send Report to: UNITA NATIONAL FOREST Telephone No: 377-5740

Address: 88 W 100 N PROVO, UTAH Zip: 84603

1 TC PC 1 TH PM BOD Nut Bact Pest THM Rad Spec

<u> </u> BOD	<u> </u> Cyanide	<u> </u> MPN Total Coliforms/100 ml
<u> </u> TSS	<u> </u> Phenolics	<u> </u> MPN Fecal Coliforms/100 ml
<u> </u> TKN	<u> </u> Sulfide	<u> </u> MF Total Coliforms/100 ml
<u> </u> TOC	<u> </u> pH	<u> </u> MF Fecal Coliforms/100 ml
<u> </u> COD	<u> </u> Oil & Grease	<u> </u> Fecal Streptococci/100 ml
		<u> </u> Plate Count - Org./ml

CATIONS		ANIONS	TOTAL METALS	
<u> </u> Ammonia	<u> </u> Lead	<u> </u> Bicarbonate	<u> </u> Aluminum	<u>X</u> Lead
<u> </u> Arsenic	<u> </u> Magnesium	<u> </u> Carbon Dioxide	<u>X</u> Arsenic	<u>X</u> Manganese
<u> </u> Barium	<u> </u> Manganese	<u> </u> Carbonate	<u>X</u> Barium	<u>X</u> Mercury
<u> </u> Boron	<u> </u> Nickel	<u> </u> Chloride	<u> </u> Beryllium	<u> </u> Molybdenum
<u> </u> Cadmium	<u> </u> Potassium	<u> </u> CO ₃ Solids	<u>X</u> Cadmium	<u> </u> Nickel
<u> </u> Calcium	<u> </u> Selenium	<u> </u> Fluoride	<u>X</u> Chromium	<u>X</u> Selenium
<u> </u> Chromium	<u> </u> Silver	<u> </u> Hydroxide	<u> </u> Cobalt	<u>X</u> Silver
<u> </u> Chromium, Hex	<u> </u> Sodium	<u> </u> Nitrate	<u>X</u> Copper	<u> </u> Vanadium
<u> </u> Copper	<u> </u> Zinc	<u> </u> Nitrite	<u>X</u> Iron	<u>X</u> Zinc
<u> </u> Iron		<u> </u> Phosphorus, Ortho		
		<u> </u> Silica		
		<u> </u> Sulfate		

 Total Phosphorus
X Total Alk. as CaCO₃
 Total Hardness as CaCO₃
 Turbidity as NTU
 Sp. Cond. (umhos/cm)
X TDS @ 180°C
 Other: _____

 Alpha, Gross 228Radium
 Beta, Gross Uranium
 226Radium

LOWER PAC.MINE PORTAL ACROSS STREAM FROM BAKE
UINTA NATIONAL FOREST

88 W 100 N

PROVO

UT

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: LOWER PAC.MINE PORTAL ACROSS STREAM FROM BAKE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802863 Type: 04

Sample Date: 88/05/18 Time: 10:45

Total Cations:

Total Anions: 109 me/l Cations:

Gr Total: 109 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/06/22

Organic Review:

Radiochemistry Review:

3.6 Microbiology Review:

Laboratory Analyses

Total Alk.	183 mg/l	TDS @ 180C	204 mg/l
Total Arsenic	<1.0 ug/l	Total Barium	0.036 mg/l
Total Cadmium	<1 ug/l	Total Chromium	<5.0 ug/l
Total Copper	<20.0 ug/l	Total Iron	0.048 mg/l
Total Lead	<5.0 ug/l	Total Manganese	6.0 ug/l
Mercury	<0.2 ug/l	Total Selenium	<0.5 ug/l
Total Silver	<2.0 ug/l	Total Zinc	<20.0 ug/l

UTAH STATE HEALTH LABORATORY

2863

Environmental Chemistry Water Analysis

Water System No. _____ Source No. _____ Date Collected 8-5-82 Time Collected 10:45
yy/mm/dd 24 hr clockExact Description of Sampling Point: LOWER PAC MINE POREAL
ACROSS STREAM FROM BAKER FORK JUNK.Collector: PAUL H. SKABELUND County: _____ Cost Code: 8508Send Report to: UNITA NATIONAL FOREST Telephone No: 377-5780Address: 88 W 100 N PRIMO, UTAH Zip: 846031 TC PC 2 TM PH BOD Nut Bact Pest THM Rad Spec

<u> </u> BOD	<u> </u> Cyanide	<u> </u> MPN Total Coliforms/100 ml
<u> </u> TSS	<u> </u> Phenolics	<u> </u> MPN Fecal Coliforms/100 ml
<u> </u> TKN	<u> </u> Sulfide	<u> </u> MF Total Coliforms/100 ml
<u> </u> TOC	<u> </u> pH	<u> </u> MF Fecal Coliforms/100 ml
<u> </u> COD	<u> </u> Oil & Grease	<u> </u> Fecal Streptococci/100 ml
		<u> </u> Plate Count - Org./ml

CATIONS		ANIONS	TOTAL METALS	
<u> </u> Ammonia	<u> </u> Lead	<u> </u> Bicarbonate	<u> </u> Aluminum	<u>X</u> Lead
<u> </u> Arsenic	<u> </u> Magnesium	<u> </u> Carbon Dioxide	<u>X</u> Arsenic	<u>X</u> Manganese
<u> </u> Barium	<u> </u> Manganese	<u> </u> Carbonate	<u>X</u> Barium	<u>X</u> Mercury
<u> </u> Boron	<u> </u> Nickel	<u> </u> Chloride	<u> </u> Beryllium	<u> </u> Molybdenum
<u> </u> Cadmium	<u> </u> Potassium	<u> </u> CO ₃ Solids	<u>X</u> Cadmium	<u> </u> Nickel
<u> </u> Calcium	<u> </u> Selenium	<u> </u> Fluoride	<u>X</u> Chromium	<u>X</u> Selenium
<u> </u> Chromium	<u> </u> Silver	<u> </u> Hydroxide	<u> </u> Cobalt	<u>X</u> Silver
<u> </u> Chromium, Hex	<u> </u> Sodium	<u> </u> Nitrate	<u>X</u> Copper	<u> </u> Vanadium
<u> </u> Copper	<u> </u> Zinc	<u> </u> Nitrite	<u>X</u> Iron	<u>X</u> Zinc
<u> </u> Iron		<u> </u> Phosphorus, Ortho		
		<u> </u> Silica		
		<u> </u> Sulfate		

 Total Phosphorus
X Total Alk. as CaCO₃
 Total Hardness as CaCO₃
 Turbidity as NTU
 Sp. Cond. (umhos/cm)
X TDS @ 180°C
 Other: _____

RADIOLOGICS

 Alpha, Gross ²²⁸Radium
 Beta, Gross Uranium
 ²²⁶Radium

R-DATE/SAMPLE-NUMBER.: [#/]

01

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MO ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork above Bog Mine]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][V][N][D][][][][]

DATE: [8][8][0][7][2][0] TIME: [1][0][2][5] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[1][0].[0]	CO2:	[][][][]
pH:	[][6].[7]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][][]
SP. COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][][]	FLOW (CFS):	[][][][][][][][][][]

SAMPLE BOTTLES NEEDED

CL. ☐ STRY: [2]

NUTRIENTS: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW

Jump = .07' width = 3.6' Depth = .3'

01

R-DATE/SAMPLE-NUMBER.: [#2]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMO ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [ADIT OF LOWER BOG MINE]

COLLECTOR: [P][A][V][L][][H][][S][K][A][B][E][L][V][W][D][][][][]

DATE: [8][8][0][7][2][0] TIME: [1][1][3][5] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[0][9].[0]	CO2:	[][][][][]
pH:	[][5].[2]	DEPTH:	[][][][][][]
D.O.:	[][][]	CL RESID.:	[][][][]
SP.COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][][]	FLOW (GPM):	[][][][][][]
TRANSPARENCY:	[][][][]	FLOW (CFS):	[][][][][][][][][]

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [2]

NUTRIENTS: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .02 1.3' = width Depth = .25'

01:

R-DATE/SAMPLE-NUMBER.: [#3]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MOI RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [NORTH FORK AMERICAN FORK BELOW LOWELL BOG MINE]

COLLECTOR: [P] [A] [V] [L] [] [H] [] [S] [K] [A] [B] [E] [L] [U] [N] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0] TIME: [1] [1] [5] [0] TYPE: [] []
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[1] [1] [.] [5]	CO2:	[] [] [] [] [] []
pH:	[] [6] [.] [8]	DEPTH:	[] [] [] [] [.] []
D.O.:	[] [] [.] []	CL RESID.:	[] [.] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [.] [] []
SP. GRAVITY:	[] [.] [] [] [] []	FLOW (GPM):	[] [] [] [] [.] []
TRANSPARENCY:	[] [.] [] []	FLOW (CFS):	[] [] [] [] [] [] [] [2] [.] [4]

SAMPLE BOTTLES NEEDED

CH TRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .03' Width = 5' Depth = .35'

R-DATE/SAMPLE-NUMBER.: [43A]

OT

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MO ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork River Above Pacific Mine]

COLLECTOR: [P] [A] [U] [L] [] [A] [] [S] [K] [A] [B] [E] [L] [U] [M] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0] TIME: [1] [4] [0] [5] TYPE: [] [] []
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[1] [6] [0]	CO2:	[] [] [] [] []
pH:	[] [6] [7]	DEPTH:	[] [] [] [] [] []
D.O.:	[] [] [] []	CL RESID.:	[] [] [] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [] [] [] []
SP. GRAVITY:	[] [] [] [] [] []	FLOW (GPM):	[] [] [] [] [] [] []
TRANSPARENCY:	[] [] [] [] [] []	FLOW (CFS):	[] [] [] [] [] [] [] [7] [0]

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .10' Width = 5.5' Depth = .5'

R-DATE/SAMPLE-NUMBER.: [#4]

01:

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MONITORING RUN: []

STOKET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [PACIFIC MINE - MAIN ADIT]

COLLECTOR: [P][A][V][L][][H][][B][K][A][B][E][L][V][W][D][][][][]

DATE: [9][8][0][7][2][0] TIME: [][][][] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[][7].[0]	CO2:	[][][][]
pH:	[][6].[5]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][][][][]

SAMPLE BOTTLES NEEDED

CHISTRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = 04' . width = 1 ft Depth = .15'

R-DATE/SAMPLE-NUMBER.: [#5]

01

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MO [] RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [PACIFIC MINE - NW PORTAL]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [K] [A] [B] [E] [L] [W] [N] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0] TIME: [1] [3] [0] [0] TYPE: [] []
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[8] [0] [0]	CO2:	[] [] [] [] []
pH:	[] [] [] []	DEPTH:	[] [] [] [] [] []
D.O.:	[] [] [] []	CL RESID.:	[] [] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [] [] []
SP. GRAVITY:	[] [] [] [] []	FLOW (GPM):	[] [] [] [] [] []
TRANSPARENCY:	[] [] [] []	FLOW (GFS):	[] [] [] [] [] [] [] []

SAMPLE BOTTLES NEEDED

CH [] TRY: [2]

NUTRIENTS: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Same as from Mine Portal at sample site #4

01

R-DATE/SAMPLE-NUMBER.: [#6]

]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMO ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [Pacific Mine - Center of Tailings]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [K] [A] [B] [E] [L] [U] [N] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0]
Y Y M M D D

TIME: [1] [3] [1] [0]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[2] [0] [0]	CO2:	[] [] [] [] []
pH:	[] [6] [7]	DEPTH:	[] [] [] [] [] []
D.O.:	[] [] [] []	CL RESID.:	[] [] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [] [] []
SP. GRAVITY:	[] [] [] [] [] []	FLOW (GPM):	[] [] [] [] [] []
TRANSPARENCY:	[] [] [] []	FLOW (CFS):	[] [] [] [] [] [] [] [] []

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW

R-DATE/SAMPLE-NUMBER.: [#7]

01.

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MC [] RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: []

COLLECTOR: [P][A][V][L][][H][][S][K][A][B][E][L][V][W][D][][][][]

DATE: [8][8][0][7][2][0] TIME: [1][4][2][5] TYPE: [][]
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[2][0].[0]	CO2:	[][][][]
pH:	[][6].[7]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][][]
SP. COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][][][]

SAMPLE BOTTLES NEEDED

CHEMISTRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .03' Depth = .15' Width = 2.75'

R-DATE/SAMPLE-NUMBER.: [#8]

]

01

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMO ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork River Below Pacific Mine]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][V][N][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][4][5][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:

[1][7].[0]

CO2:

[][][][][]

pH:

[][6].[9]

DEPTH:

[][][][][][]

D.O.:

[][][][]

C1 RESID.:

[][][][]

SP. COND.:

[][][][][][]

FLOW (MGD):

[][][][]

SP. GRAVITY:

[][][][][]

FLOW (GPM):

[][][][][][]

TRANSPARENCY:

[][][][]

FLOW (CFS): [][][][][][][][7].[6]

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [2]

NUTRIENTS: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .04' Depth = .5' Width = 6 ft'
Site located just upstream from Mouth of Dry Fork

R-DATE/SAMPLE-NUMBER.: [#9]

]

01.

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMC ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork River @ Dutchman Flat]

COLLECTOR: [P] [A] [V] [L] [] [H] [] [S] [K] [A] [B] [G] [L] [W] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [0]
Y Y M M D D

TIME: [1] [4] [3] [5]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[1] [6] [.] [5]	CO2:	[] [] [] [] [] []
pH:	[] [6] [.] [8]	DEPTH:	[] [] [] [] [.] []
D.O.:	[] [] [.] []	CI RESID.:	[] [.] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [.] [] []
SP. GRAVITY:	[] [.] [] [] []	FLOW (GPM):	[] [] [] [] [.] []
TRANSPARENCY:	[] [] [.] []	FLOW (CFS):	[] [] [] [] [] [] [6] [.] [7]

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [2]

NUTRIENTS: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .15' Width = 8' Depth = .67'

DESCRIPTION: [MARY EL^LEEN GULCH CREEK AT MOUTH]

COLLECTOR: [P][A][U][L][][H][][S][K][A][B][E][L][U][W][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [][6][][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[][5].[0]	CO2:	[][][][]
pH:	[][6].[8]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][][][]

SAMPLE BOTTLES NEEDED

CHEMISTRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .14' Width = 3.2' Depth = .18'

01

R-DATE/SAMPLE-NUMBER.: [#11]

]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMO. ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [North Fork American Fork below Mary Ellen Gulch]

COLLECTOR: [P][A][U][L][][H][][S][A][A][B][C][L][U][N][D][][][][]

DATE: [8][8][0][7][2][0]
Y Y M M D D

TIME: [1][6][3][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[1][7].[0]	CO2:	[][][][]
pH:	[][6].[9]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][]
SP. COND.:	[][][][][]	FLOW (MGD):	[][][]
SP. GRAVITY:	[][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][]	FLOW (CFS):	[][][][][][][][8].[2]

SAMPLE BOTTLES NEEDED

CH. ☐ TRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .03' Depth = .625' Width = 7'

R-DATE/SAMPLE-NUMBER.: #12

01.

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMC ☐ RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARY ELLEN GULCH CREEK ABOVE MINE TAILINGS]

COLLECTOR: [P] [A] [V] [L] [] [H] [] [S] [K] [A] [B] [E] [L] [V] [N] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [/]
Y Y M M D D

TIME: [0] [9] [4] [0]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[] [9] [.] [0]	CO2:	[] [] [] [] []
pH:	[] [6] [.] [7]	DEPTH:	[] [] [] [] [.] []
D.O.:	[] [] [.] []	CL RESID.:	[] [.] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [.] [] []
SP. GRAVITY:	[] [.] [] [] []	FLOW (GPM):	[] [] [] [] [.] []
TRANSPARENCY:	[] [] [.] []	FLOW (CFS):	[] [] [] [] [] [] [.] [2] [2]

SAMPLE BOTTLES NEEDED

CH ☐ TRY: [2]

NUTRIENTS: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .02' Width = 1.5' Depth = .13'

01

R-DATE/SAMPLE-NUMBER.: [#13

]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MOI RING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARY ~~ELLEN~~ ELLEN MINE PORTAL]

COLLECTOR: [P][A][V][L][][H][][S][A][A][B][G][L][U][N][D][][][][]

DATE: [8][8][0][7][2][1]
Y Y M M D D

TIME: [1][0][0][0]

TYPE: [][]

FIELD TESTS

TEMPERATURE:	[][7].[0]	CO2:	[][][][]
pH:	[][6].[5]	DEPTH:	[][][][][]
D.O.:	[][][]	CL RESID.:	[][][][]
SP. COND.:	[][][][][][]	FLOW (MGD):	[][][][]
SP. GRAVITY:	[][][][][]	FLOW (GPM):	[][][][][]
TRANSPARENCY:	[][][][]	FLOW (CFS):	[][][][][][][][][]

SAMPLE BOTTLES NEEDED

CHEM TRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW *Jump = .03' Width = 1.0' Depth = .21'*

R-DATE/SAMPLE-NUMBER.: [#13A]

01.

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

103932

MONITORING RUN: []

STATION: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [West Fork Mary Ellen Gulch Creek @ Mouth]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [K] [A] [B] [G] [L] [U] [N] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [1]
Y Y M M D D

TIME: [1] [1] [0] [0]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[1] [3] . [0]	CO2:	[] [] [] [] [] []
pH:	[] [6] . [7]	DEPTH:	[] [] [] [] [] []
D.O.:	[] [] [] []	CL RESID.:	[] [] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [] [] []
SP. GRAVITY:	[] [] [] [] [] []	FLOW (GPM):	[] [] [] [] [] []
TRANSPARENCY:	[] [] [] []	FLOW (CFS):	[] [] [] [] [] [] [] [] [] []

SAMPLE BOTTLES NEEDED

CHEMISTRY: [2] - T-ALK, HRONS, SO₄, TDS

NUTRIENT: [2]

TOTAL METALS: [2] - As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Se, Ag, Zn

FIELD COMMENTS: TAKE FLOW Jump = .07' Width = 1.5' Depth = .3'

01

R-DATE/SAMPLE-NUMBER.: [#13A]

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAM

MONITORING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [West Fork Mary Ellen Gulch Creek @ Mouth]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [K] [A] [B] [G] [L] [U] [W] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [1]
Y Y M M D D

TIME: [1] [1] [0] [0]

TYPE: [] []

FIELD TESTS

TEMPERATURE:	[1] [5] [.] [0]	CO2:	[] [] [] [] [] []
pH:	[] [6] [.] [7]	DEPTH:	[] [] [] [] [.] []
D.O.:	[] [] [.] []	CL RESID.:	[] [.] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [.] [] []
SP. GRAVITY:	[] [.] [] [] [] []	FLOW (GPM):	[] [] [] [] [.] []
TRANSPARENCY:	[] [] [.] []	FLOW (CFS):	[] [] [] [] [] [] [.] [6]

SAMPLE BOTTLES NEEDED

CHLORINE TRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .07' Width = 1.5' Depth = .3'

R-DATE/SAMPLE-NUMBER.: [#14]

]

01.

UTAH STATE WATER QUALITY SYSTEM
MONITORING RUN PROGRAMMC ☐ DRING RUN: []

STORET: [] SOURCE: [] COUNTY: [] USE: [] COST CODE: []

DESCRIPTION: [MARY ELLEN GULCH CR. BELOW MINE TAILINGS]

COLLECTOR: [P] [A] [U] [L] [] [H] [] [S] [A] [A] [B] [E] [L] [U] [N] [D] [] [] [] []

DATE: [8] [8] [0] [7] [2] [1] TIME: [1] [1] [3] [5] TYPE: [] []
Y Y M M D D

FIELD TESTS

TEMPERATURE:	[/] [3] . [5]	CO2:	[] [] [] [] []
pH:	[] [6] . [7]	DEPTH:	[] [] [] [] [] []
D.O.:	[] [] [] []	CL RESID.:	[] [] [] []
SP. COND.:	[] [] [] [] [] []	FLOW (MGD):	[] [] [] []
SP. GRAVITY:	[] [] [] [] [] []	FLOW (GPM):	[] [] [] [] [] []
TRANSPARENCY:	[] [] [] []	FLOW (CFS):	[] [] [] [] [] [] [2] [1]

SAMPLE BOTTLES NEEDED

CHEMISTRY: [2]

NUTRIENT: [7]

TOTAL METALS: [2]

FIELD COMMENTS: TAKE FLOW Jump = .04 width = 3.0' Depth = .43'

FOR AGENCY USE ONLY			UNITED STATES DEPARTMENT OF AGRICULTURE					
PAUL-1 5/19/88			PURCHASE ORDER					
1 PAGE NO.	2 RECEIVING OFF	3 CONTRACT NUMBER	4 ORDER DATE	5 SF-281	6 UNIT CODE	7 FUND CODE	8 ORDER NUMBER	9 SUB.
01	01	ON	05/20/88	AT	18	1P	43-8462-8-1447	
10 TYPE PURCHASE (Check one)								
<input checked="" type="checkbox"/> PURCHASE ORDER			<input type="checkbox"/> DELIVERY ORDER					
10a Name, Address, City, State, Zip Code, and Phone No.)			11 Consignee, Address, Zip Code and Place of Inspection and Acceptance					
UTAH STATE HEALTH DEPARTMENT WATER LAB-STATE HEALTH LABORATORY 44 MEDICAL DRIVE SALT LAKE CITY UT 84113 (801)533-6131			UTAH NATIONAL FOREST PO#43-8462-8-1447(PAUL SKABELUND) 88 WEST 100 NORTH PROVO UT 84601 (801)586-5710					
			SHIP TO					
			PHONE (A/C & No.)			Check One FTS <input checked="" type="checkbox"/> COMM <input type="checkbox"/>		
12 LINE ITEM	13 ACT CODE	14 DESCRIPTION	15 BUDGET OBJECT	16 ACC LINE	17 QUANTITY	18 UNIT ISSUE	19 UNIT PRICE	20 AMOUNT
01		ANALYSIS - WATER SAMPLES FOR THE FOLLOWING HEAVY METALS: A. ARSENIC; B. BARIUM; C. CADMIUM; D. CHROMIUM; E. COPPER; F. IRON; G. LEAD; H. MANGANESE; I. MERCURY; J. SELENIUM; K. SILVER; L. ZINC AND ALSO FOR ALKALINITY AND TOTAL DISSOLVED SOLIDS.	2500	01	14	EA	85.00	1190.00
02		ANALYSIS - WATER SAMPLE IN SMALL CONTAINER FOR ALKALINITY AND TOTAL DISSOLVED SOLIDS	2500	01	1	EA	15.00	15.00
20a THIS PURCHASE ORDER NEGOTIATED PURSUANT TO AUTHORITY OF 41 U.S.C. 252(c)(1).								
21 F.O.B. POINT DESTINATION			22 DISCOUNT AND/OR NET PAYMENT TERMS Net 30 Days			23 TYPE COMMODITY/ PAYMENT CODE 0		25 Sub-Total 1205.00
23 DELIVER TO F.O.B. POINT ON OR BEFORE (Date) PER CONTRACT			24 SHIP VIA			26 ESTIMATED FREIGHT .00		27 TOTAL 1205.00
28 ACCOUNTING CLASSIFICATION							30 DISTRIBUTION	
28 ACC LINE	A	B	C	D	E		31 AMOUNT	
1	5	10	3	4	0 0062 1			
31a ORDERED BY (Name and Title) GLENNA FORBUSH PURCHASING AGENT					31c COMMERCIAL PHONE (Area Code and Number) (801)896-2491		31d FTS PHONE NO.	
31e AUTHORIZED SIGNATURE								
31f OFFICE NAME AND ADDRESS UDA FOREST SERVICE UTAH SOUTH ACQUISITION CENTER 115 E 900 NORTH RICHFIELD UT 84701								

AGENCY USE COPY

FORM AD - 838 (REV. 3/84)

Paul Skabelund

WEST FORK-MARY-ELLEN GULCH CREEK @ MOUTH
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: WEST FORK MARY ELLEN GULCH CREEK @ MOUTH

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8803932 Type: 04

Sample Date: 88/07/21 Time: 11:00

Tot. Cations: 43

Tot. Anions: 103 me/l Cations:

and Total: 146 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/08/22

Organic Review:

2.5 Radiochemistry Review:

2.6 Microbiology Review:

Laboratory Analyses

Sulfate 67 mg/l
T. Hardns. 121.7 mg/l
T-Arsenic 14.5 ug/l
T-Cadmium 2 ug/l
T-Copper 53.0 ug/l
T-Lead 10.0 ug/l
Mercury <0.2 ug/l
T-Silver <2.0 ug/l

Tot. Alk. 60 mg/l
TDS @ 180C 190 mg/l
T-Barium 0.022 mg/l
T-Chromium <5.0 ug/l
T-Iron 1.2 mg/l
T-Manganese 74.0 ug/l
T-Selenium <0.5 ug/l
T-Zinc 450.0 ug/l

Site No.	Station	Date	Arsenic ug/l.	Cadmium ug/l.	Copper ug/l.	Lead ug/l.	Mercury ug/l.	Silver ug/l.	Barium ng/l.	Chromium ug/l.	Iron mg/l.	Manganese ug/l.	Nickel ug/l.	Zinc ug/l.	Sulfide Mg/l.
7	Effluent from Main Pacific Mine - Lower End of Tailings	8/19/88	22.5 32.0	31 9	60.0 30.0	4,000 850.0	.63 .29	5.0	0.28 	<5.0	5.3	23.0	<0.5	1,600.0 1,000.0	
8	North Fork American River Below Pacific Mine	7/26/88 9/22/88	4.5 	<1 ->	<20.0 ->	20.0 ->	<0.2							81.0 ->	23
9	North Fork American River @ Dutchman Flat	8/10/88 7/26/88 9/22/88	2.5 -> ->	<1 -> ->	<20.0 -> ->	60.0 5.0 5.0	<0.2 -> ->	<2.0 -> ->	0.056 0.053	<5.0 -> ->	0.45 0.029	31.0 7.0	<0.5 -> ->	77.0 43.0 37.0	16 21
10	Mary Ellen Creek @ Mouth	7/26/88	2.5	<1 ->	<20.0 ->	<5.0 5.0	<0.2	<2.0	0.046	<5.0	0.059	6.0	<0.5	72.0 41.0	33 26
11	North Fork American River below Mary Ellen Gulch	7/26/88 9/22/88	3.5	<1 ->	<20.0 ->	10.0 ->	<0.2	<2.0	0.053	<5.0	0.089	7.0	<0.5	40.0 99.0	29 52
12	Mary Ellen Gulch Creek Above Mixed Areas	7/26/88 9/22/88	1.5	<1 ->	<20.0 ->	<5.0 ->	<0.2	<2.0	0.041	<5.0	0.035	<5.0	<0.5	<20.0 22.0	22 3

Site No.	Station	Date	Arsenic ug/l.	Cadmium ug/l.	Copper ug/l.	Sulfate Mg/l.	Total Solids mg/l.	Total Suspended Solids mg/l.	TDS mg/l.	Flow CFS.
7	Effluent from Main Pacific Mine - Lower End of Tailings	5/15/88	22.5	31	60.0		164	200		
		7/20/88	22.0	9	30.0					
8	North Fork American Fork River Below Pacific Mine	7/20/88	4.5	<1	<20.0	23	141.6	115	134	
		9/22/88		<1	<20.0			119	156	
9	North Fork American Fork River @ Dutchman Flat	5/15/88	2.5	<1	<20.0	16	157.3	83	102	
		7/20/88	<1.0	<1	<20.0	21	166.4	143	174	
		9/22/88		<1	<20.0			143	168	
10	Mary Ellen Creek @ Mouth	7/20/88	2.5	<1	<20.0	33	135.8	109	154	
				<1	<20.0	26	162.3	136	190	
11	North Fork American Fork River below Mary Ellen Gulch	7/20/88	3.5	<1	<20.0	20	150.7	135	158	
		9/22/88		<1	<20.0	52	156.5	89	186	
12	Mary Ellen Gulch Creek Above Mined Areas	7/20/88	1.5	<1	<20.0	22	110.1	92	120	
		9/22/88		<1	<20.0	30	111.0	80	132	

Site No.	Station	Date	Arsenic ug/l.	Cadmium ug/l.	Copper ug/l.	Lead ug/l.	Mercury ug/l.	Silver ug/l.	Barium mg/l.	Chromium ug/l.	Iron mg/l.	Manganese ug/l.	Selenium ug/l.	Zinc ug/l.	Sulfate mg/l.
13	Mary Ellen Mine Portal	5/10/88	100	4	40.0	10.0	< 2	< 2.0	0.019	< 5.0	9.9	140	< 0.5	1,200.0	
		7/2/88	97	1	< 20.0	< 5.0								570.0	
		9/11/88		< 1	< 20.0	< 5.0								140.0	73
13A	North West Fork Mary Ellen Gulch	7/10/88	14.5	2	53.0	10.0	< 2	< 2.0	0.022	< 5.0	1.2	74.0	< 0.5	450	67
		9/11/88		2	< 20.0	< 5.0								390	84
14	Mary Ellen Gulch Creek Downstream from Mines	5/10/88	< 1.0	2	42	40.0	< 0.2	< 2.0	0.039	< 5.0	1.1	46.0	< 0.5	310	
		7/2/88	3.0	< 1	< 20.0	< 5.0								110	38
		9/11/88		< 1	< 20.0	< 5.0								92	69
3A	North Fork American Fork River Above Pacific Mine	7/10/88	1.0	< 1	< 20.0	< 5.0	< 0.2	< 2.0	0.044	< 5.0	0.033	< 5.0	< 0.5	< 20.0	18
		7/11/88		< 1	< 20.0	< 5.0								< 20.0	25
-	Miller Hill Mine downstream From Pacific Mine	5/10/88	< 1.0	< 1	< 20.0	< 5.0	< 0.2	< 2.0	0.034	< 5.0	0.048	6.0	< 0.5	< 20.0	

Site No	Station	Date	Arsenic mg/l.	Cadmium mg/l.	Copper mg/l.	Chloride mg/l.	Sulfate mg/l.	Total Hardness mg/l.	Total Alkalinity mg/l.	TDS mg/l.	Flow C.F.S.
13	Mary Ellen Mine Portal	5/10/88	100	4	40.0	< 0.0			36	206	
		7/21/88	97	1	< 20.0	< 0.0					
		9/11/88		< 1	< 20.0	< 0.0	73	115.1	40	196	
13A	Mouth West Fork Mary Ellen Gulch	7/11/88	14.5	2	53.0		67	121.7	60	190	
		9/14/88		2	< 20.0	<	84	124.2	33	182	
14	Mary Ellen Gulch Creek Downstream from Mines	5/10/88	< 1.0	2	42				92	132	
		7/21/88	3.0	< 1	< 20.0	<	38	137.4	100	138	
		9/11/88		< 1	< 20.0	<	69	136.8	62	166	
3A	North Fork American Fork River Above Pacific Mine	7/20/88	1.0	< 1	< 20.0	< 0	18	120.9	104	130	
		9/12/88		< 1	< 20.0	< 0	25	134.9	109	148	
	Miller Hill Mine downstream from Pacific Mine	5/10/88	< 1.0	< 1	< 20.0	< 0			183	204	

WATER QUALITY SAMPLING - UPPER AMERICAN FORK CANYON

Station	Date	Arsenic ug/l	Calcium ug/l	Copper ug/l	Lead ug/l	Mercury ug/l	Silver ug/l	Barium mg/l	Chromium ug/l	Iron mg/l	Manganese ug/l	Selenium ug/l	Zinc ug/l	Sulfate mg/l
North Fork American Fork River Above Bog Mine	7/10/88	<1.0	<1	<20.0	<5.0	0.2	<2.0	0.037	<5.0	0.16	24.0	<0.5	28.0	29
Lower Bog Mine	5/18/88	1.5	12	<20.0	<5.0	<0.2	<2.0	0.037	<5.0	7.9	270	<0.5	510.0	
	7/10/88	3.0	13		5.0								530.0	
	7/14/88		8	<20.0	<5.0								480.0	51
North Fork American Fork below Lower Bog Mine	7/20/88	2.5	1		<5.0								72.0	31
	7/20/88		4	<20.0	<5.0								190.0	44
Portal Pacific Mine	5/18/88	22.0	6	54.0	25.0	0.2	<2.0	0.063	<5.0	4.0	11.0	<0.5	900.0	
	7/20/88	20.0	13	42.0	15.0	<0.2							1,600.0	
	9/10/88		5	<20.0	<5.0								950.0	40
NW Portal Pacific Mine	5/12/88	1.0	<1	<20.0	60.0	<0.2	<2.0	0.15	<5.0	0.031	19.0	<0.5	72.0	
	7/20/88	2.0			<5.0									
Center of Tailings below Main Pacific Mine Portal	5/18/88	24.0	9	62.0	180.0	<0.2	<2.0	0.11	<5.0	6.6	23.0	<0.5	1,300.0	
(from Runoff) →	7/10/88	13.0	8	30.0	175.0								1,000.0	
	5/10/88 (90.0)		(51)	(260.0)	(20,000.0)	(3.24)	(45.0)	(0.15)	(<5.0)	(13.0)	(48.0)	(1.0)	7,700.0	

WATER QUAL

No	Station	As Arsenic ug/l	Calcium mg/l	Sulfate mg/l	Total Hardness mg/l	Total Alkalinity mg/l	TDS mg/l	Flour CAS.
1	North Fork American Fe River Above Bog Mine	<1.0	<1	<20.0	29	11	91	128
2	Lower Bog Mine	5/18/88 1.5 7/20/88 3.0 9/12/88	12 13 8	<20.0 <20.0	51	39.3	0	90 72
3	North Fk. American Fork below Lower Bog Mine	7/20/88 2.5 9/20/88	1 4	<20.0	31 45	96.9 106.0	73 53	120 138
4	Portal Pacific Mine	5/18/88 22.0 7/20/88 20.0 9/12/88	6 13 5	54.0 42.0 <20.0	40	204.4	123 0	202 356
5	NW Portal Pacific Mine	5/18/88 1.0 7/20/88 2.0	<1	<20.0			128	208
6	Center of Tailings below Main Pacific Mine Portal (from Runoff) →	5/18/88 24.0 7/20/88 13.0 5/18/88 (90.0)	9 8 (51)	62.0 30.0 (260.0)			152 21	202 140

**AMERICAN FORK HYDROLOGY
AND
WATER QUALITY STUDY**



Lidstone & Anderson, Inc.

Water Resources and Environmental Consultants

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FEB 06 1993

DIVISION OF
OIL, GAS, & MINING

**AMERICAN FORK HYDROLOGY
AND
WATER QUALITY STUDY**

PREPARED FOR:

Utah Division of Oil, Gas and Mining
Abandoned Mine Reclamation Program
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1.0 INTRODUCTION

A water quality investigation was conducted at several abandoned mine sites in the American Fork Canyon, Utah County, Utah during the three day period of July 7th through the 9th, 1992. The project was cooperatively funded by the Utah Division Oil, Gas and Mining (DOGM), Abandoned Mine Reclamation Program (AMR) and the U.S. Forest Service, Uinta National Forest. Several previous studies had been conducted in the area including:

- (1) Merritt, Laverie B., 1988; "Preliminary Survey of Water Quality in Mine Drainage in Sheeprock Mountains and North Fork of the American Fork River." (Water Quality).
- (2) Mangum, Fred, 1988; "Aquatic Ecosystem Inventory, Macroinvertebrate Analysis; Annual Progress Report, Uinta National Forest". (Water Quality and Macroinvertebrates).
- (3) Kastning-Culp, Nancy, et.al., 1992; "Year End Report On Mitigation Systems for Hard Rock Mine Effluent in Utah". (Soils, Water Quality, Vegetation, Ecosystems).

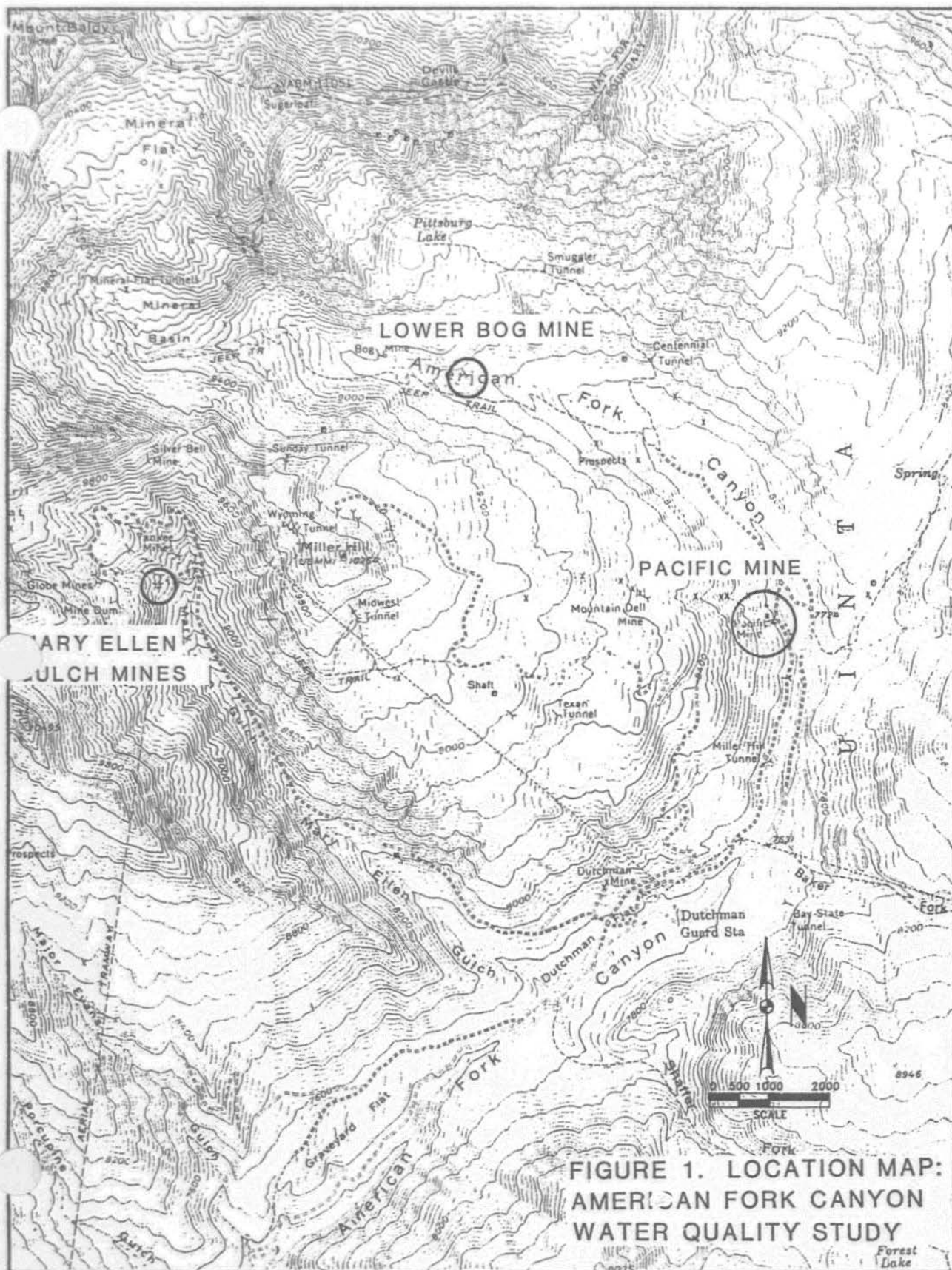
1.1 Site Conditions

The American Fork Canyon Mining District is characterized by inactive underground mine workings, shafts, portals, spoils and tailings located in the Uinta National Forest. The majority of these workings are associated with valid mining claims. A number of abandoned mine sites have been inventoried by the Utah DOGM in the past. The scope of the current sampling study was to specifically investigate three mine drainage problem areas: the Pacific Mine, the Lower Bog Mine and the Mary Ellen Gulch Mines (Figure 1).

In many cases the underground workings of inactive mines are flooded by ground water. This ground water comes in contact with the mineralized rock, spent ore and/or tailings, which results in changes in water chemistry. Typically this change manifests itself as lower pH conditions and higher concentrations of trace metals. Where there is sufficient ground water "head" or gradient, the mine water is discharged to the surface and enters area streams. If toxic levels of trace metals are present in these mine waters, an adverse impact to area streams or aquatic life can occur.

1.2 Site Investigation

The purpose of this study is to investigate the hydrology, geochemistry and water quality impacts of mine drainage on receiving waters within the National Forest Lands. Following the analysis of the water quality impacts, a conceptual "action plan" will be developed. This report documents the sampling study, the laboratory analyses, and a mass balance analysis of the water quality in the vicinity of the three study sites.



Field investigations were conducted by Lidstone & Anderson, Inc. and a representative of the Utah Division of Oil, Gas & Mining, AMR Program to determine existing conditions. These investigations included water sample collection, flow estimates, measurements of field water quality and soil pH parameters. Additional analyses included observations of geological and mineralogical conditions, natural biological and geochemical controls or hydrochemical barrier conditions present at each site.

Flow estimates were made at each portal and in the vicinity of sample points using a bucket and stop watch. Flow estimates were made along major drainages (Mary Ellen Gulch and the North Fork of the American Fork) using a Pygmy Current Meter. Field water quality parameters included field pH (Orion Research Model No. 200), field conductivity and temperature (YSI Model No. 33) and color. Water samples were collected and handled using standard EPA sampling protocol. Samples were unfiltered, preserved in the field, packed in ice and delivered to the Utah Department of Health laboratory within 24 hours of collection. Laboratory analysis included major anions and cations, total dissolved solids, total alkalinity and selected acid soluble trace metals.

Figure 2 presents the sample sites in relationship to the mine portals and receiving streams. Field pH and laboratory TDS characterize the water quality at each sampling point. Flow discharge measurement points and estimates are presented on this figure. Table 1 documents the field sampling program, a description of each sample site and the field parameters measured at each site. The analytical results and a conceptual sketch of each site showing the relative locations of sample sites are presented in Appendix A. Gaging measurement data sheets are presented in Appendix B.

2.0 PHYSIOGRAPHIC AND GEOLOGIC SETTING

The American Fork Canyon study area is situated within the upper headwaters of the North Fork of the American Fork River in Utah County, Utah. The locations of the American Fork River and its various tributaries are shown on Figure 1. The North Fork is a south west-flowing drainage tributary to the American Fork River, which drains into Utah Lake, the Jordan River and eventually into the Great Salt Lake. The headwaters of the American Fork Canyon in the vicinity of the project area range in elevation from 9,200 to over 10,000 feet above sea level. The drainage originates in a glaciated cirque basin, known as Mineral Basin at the base of Mount Baldy. Mary Ellen Gulch is a southeast draining tributary to the North Fork of the American Fork, entering the American Fork Canyon at Dutchman's Flat. The project area within Mary Ellen Gulch ranges in elevation from 8,800 to 9,400 feet above sea level. This drainage originates in a glaciated cirque basin, known as Merrill Flat at the base of Twin Peaks.

The streams draining the divide are steep gradient cobble- to boulder-bed streams. The flow conditions of the streams range from rapid to turbulent along most of the project area reaches. The drainage pattern is dendritic with most tributaries sustaining a base flow throughout most of the year.

The geologic setting of the project area is extensively fractured and mineralized carbonate and metasedimentary rocks of Paleozoic or Precambrian Age. The oldest rocks within the

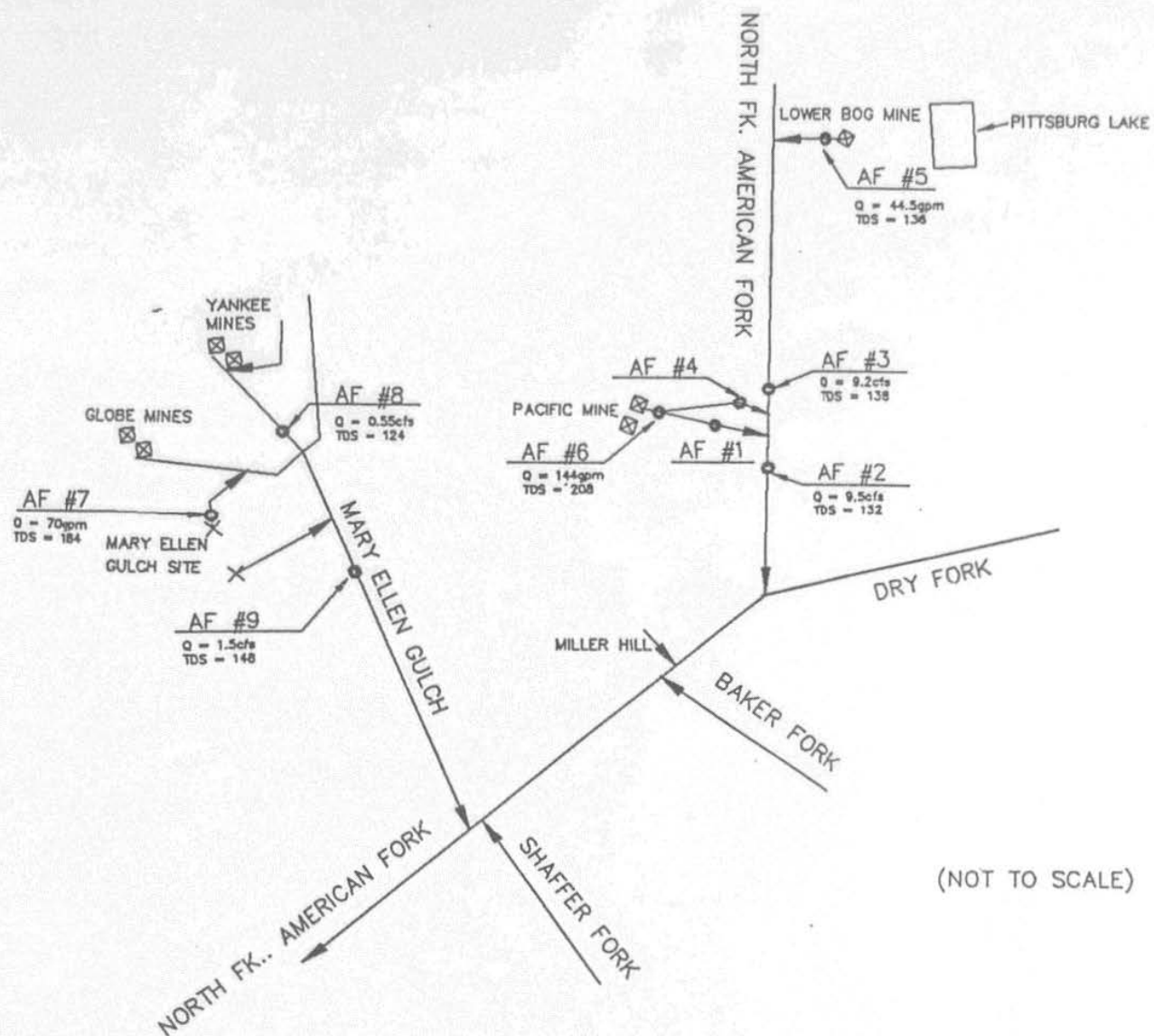


FIGURE 2. AMERICAN FORK CANYON SAMPLING SITES SCHEMATIC

Table 1. American Fork Canyon Water Sampling Program.

Sample No.	Data Collected	Time	Discharge	Field Parameters				Location
				pH (s.u)	TDS (ppm)	EC (umhos)	Temp. (°C)	
AF#1	7/8/92	12:56 PM	6.5 gpm ^a	7.8	—	325	18.3	Discharge from Pacific Mine ab. confluence w/American Fork, through tailings
AF#2	7/8/92	1:20 PM	9.5 cfs ^b	8.0	130	170	13.3	American Fork bl. Pacific Mine
AF#3	7/8/92	12:20 PM	9.2 cfs	8.4	140	150	11.3	American Fork ab. Pacific Mine
AF#4	7/8/92	12:25 PM	12 gpm	8.0	—	280	11.7	Discharge from Pacific Mine after treatment in Beaver Pond ab. confluence
AF#5	7/8/92	2:25 PM	44.5 gpm	5.1	80	—	10.1	Discharge from Lower Bog Mine Portal
AF#6	7/8/92	3:30 PM	144 gpm	6.5	180	230	7.8	Discharge from Pacific Mine Portal
AF#7	7/8/92	5:05 PM	70 gpm	5.9	140	180	8.0	Discharge from North Portal Mary Ellen Gulch
AF#8	7/8/92	5:50 PM	0.55 cfs	8.1	—	140	9.1	Mary Ellen Gulch us. of AMR and active mine disturbance
AF#9	7/8/92	7:15 PM	1.50 cfs	7.9	—	170	10.4	Mary Ellen Gulch ds. of AMR and active mine disturbance
Miscellaneous Sampling Sites								
—	7/7/92	—	2.5 gpm ^a	7.2	—	205	7.0	Mary Ellen Gulch South Portal
—	7/7/92	—	0.6 cfs ^a	7.7	—	105	10.2	Trib. North of North Portal Mary Ellen Gulch Mine us. of AMR disturbance
—	7/6/92	—	0.0 ^c	6.9	260	—	22.2	Ponded water on tailings at Pacific Mine
—	7/8/92	2:45 PM	5-9 cfs ^a	7.9	110	—	10.0	N. Fork American Fork ab. Lower Bog Mine discharge.
—	7/8/92	2:55 PM	5-9 cfs ^a	7.5	100	—	11.2	N. Fork American Fork bl. Lower Bog Mine discharge

- ^a gpm measured utilizing a stopwatch and bucket
^b cfs measured utilizing a pygmy meter
^c flow visually estimated

immediate project area compromise the Late Precambrian Big Cottonwood Formation, which consists of quartzites, shales and metasedimentary rocks. The formation is approximately 16,000 feet thick (James, L. P., 1979) and is well exposed on steeply dipping exposures along the American Fork Canyon and Mary Ellen Gulch. It is exposed along the American Fork channel immediately below the Lower Bog Mine, as well as along the steeper reaches of Mary Ellen Gulch. The Paleozoic sequence within the project area consists of the Cambrian Age Tintic Quartzite, Ophir Formation and Maxfield Limestone, and the Mississippian Age Fitchville Formation, Deseret and Gardison Limestones. The Pacific Mine portals lie within a fault graben block of Gardison Limestone. The Mary Ellen Gulch mine portals are situated in Cambrian Age Maxfield Limestone and dolomites of the Mississippian Fitchville Formation. The Lower Bog Mine portal was "driven into" the Precambrian Big Cottonwood Formation.

2.1 Geochemical Setting of the Project Area

Mineralization and ore trends within the project area are closely associated with the Miocene age emplacement of silicic, intermediate and aplite dikes of the Alta Stock (James, L.P. 1979). The rocks of the Alta Stock are typically granodiorite to quartz monzonite in composition. Mineralization and alteration trends are concordant with the extensive faulting and fracturing of the host rocks. Historical mining in the area generally followed these ore trends. The chemistry of the Alta Stock and the mineralization within the American Fork Canyon is high in copper, lead, zinc and iron. The high arsenic and cadmium concentrations present in the mineralized zones are associated with accessory minerals, which occur as the sulfides, arsenates and carbonate minerals.

The characteristics of the mine drainage chemistry are a reflection of the relationship of host rock chemistry, the surrounding equilibrium conditions of waters in contact with the mineralized or "mined zone" and upgradient ground water quality. The "mined" or mineralized zone is high in both primary sulfides, secondary sulfates and hydrous sulfates. Because of the high sulfide content of the mineralized rock, one would typically anticipate acid mine drainage from the American Fork portals. Of the three sites investigated, two sites are characterized by nearly neutral pH conditions: the Pacific Mine and the Mary Ellen Gulch Mines. In both cases the host rocks are limestones or dolomites and are rich in carbonates. Although the oxidation of the sulfides within the mineralized zones continues to occur and generate acid pH conditions, the buffering capacity of the upgradient ground water quality is such that the water is neutralized upon exiting the mine portal. Acid drainage is present at the Lower Bog Mine (pH ranges from 3.9 to 5.1). The host rock at the Lower Bog Mine is predominantly quartzites, siltstones and shales of the Big Cottonwood Formation. The host rock and the upgradient water quality does not have the capacity to buffer the acid mine drainage conditions at this site.

3.0 SAMPLING RESULTS

3.1 Lower Bog Mine

The Lower Bog Mine portal is located at an approximate elevation of 8,520 feet AMSL and consists of a single bedrock opening, tailings dump and miscellaneous spoil piles. Discharge

from the portal was gaged at approximately 44.5 gpm on July 8, 1992. The water was clear with "yellow boy" or hydrous iron oxide precipitate in the vicinity of the discharge. On that day, field pH was measured at 5.1 and the field analysis of total dissolved solids was 80 ppm. Based on the considerable amount of iron precipitate at the mouth of the portal discharge, these results were somewhat surprising. A single water sample was collected at the site. The laboratory results (Figure 3) suggest that the discharging waters were not in equilibrium at the time of sampling. A laboratory pH value of 3.9 suggested a greater change in pH (from field to lab) than would be anticipated. The laboratory cation-anion balance was 21%. Typically acceptable laboratory balance is less than 5%. The 1992 sample results are similar to the 1988 (Merriitt, 1988) sampling effort eliminating laboratory error as the sole problem.

To evaluate the impact of the Lower Bog portal discharge on the North Fork of the American Fork, field parameters were measured at various points within the hydrologic system. The portal discharge enters the main stream at two points (Figure 3): (1) as surface flow adjacent to a tailings dump and, (2) as seepage through the tailings dump. At the surface flow location, the pH had increased from the upstream value of 5.1 to 6.4. At the seepage location the pH had increased from 5.1 to 7.0, suggesting the neutralization of waters in transit from the mouth of the portal to its confluence with the main stream. On the date of sampling (7/8/92), measurements of field parameters upstream and downstream of the point of confluence were made to determine if there was any impact to the waters of the American Fork. Upstream of the portal discharge, a pH of 7.95 and total dissolved solids content (TDS) of 110 ppm were measured. Downstream of the portal discharge a pH of 7.52 and a TDS of 100 ppm were measured, suggesting that dilution is the principal mechanism for the mitigation of adverse impacts. Discharge of the receiving waters on July 8, 1992 was estimated at 3.31 cfs (from basin area reduction of measured channel discharges along the North Fork and Mary Ellen Gulch). The portal discharge was measured at 44.5 gpm or 0.1 cfs reflecting a dilution of 33:1.

The 1992 water quality analysis of the Lower Bog Mine portal indicate that excessive concentrations of trace metals (iron, cadmium, zinc, copper and lead) are associated with the portal discharge. Similar studies at the adjacent mines (Pacific and Mary Ellen Gulch) indicate that copper and iron concentrations are not problematical since these parameters are strictly pH and Eh dependent. Cadmium, zinc and lead behave in a slightly different geochemical manner. Sampling completed by Mangum, 1988 indicated that upstream concentrations of zinc averaged approximately 20 ug/l during a July and September sampling period. Downstream of the Lower Bog discharge, zinc concentration increased to 77 (in July) to 190 ug/l in September. Sampling of macroinvertebrates at two stations (Mangum, 1988) indicated that the effects of the portal discharge resulted in "stress conditions along the lower reach".

3.2 Pacific Mine

The Pacific Mine is located at an elevation of 7800 feet AMSL and consists of two discharging portals, a tailings dump, miscellaneous mine-related structures and spoil piles. An upper or northwest portal was not investigated as part of this study. Previous studies (Merriitt, 1988) had indicated that additional dissolution of trace metals occurred where the discharge from the south portal commingled with an abandoned tailings dump. Kastning-Culp, et. al., 1992 investigated the biological uptake of trace metals by an adjacent wetlands/beaver pond north of

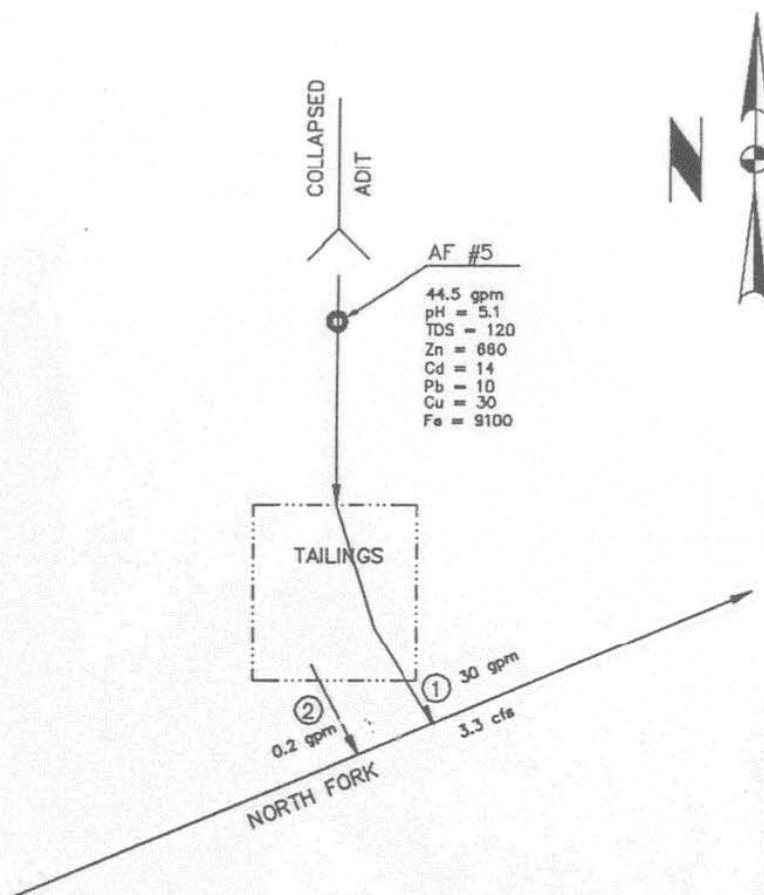


FIGURE 3. LOWER BOG SAMPLING PROGRAM

the tailings dump. The 1992 sampling program was designed to investigate the impacts of the portal discharge on the receiving waters (North Fork of the American Fork), the influence of the interaction of the tailings with the portal discharge, and the positive, if any, influence of the beaver pond on the discharging water quality. Figure 4 presents the sampling program conducted at the Pacific Mine site.

Field parameters were measured at the five sampling sites on consecutive days and were found to be repeatable during the sampling period. Drainage from the main portal (AF#6) is characterized by a near neutral (6.54) pH, iron precipitate and high concentrations of trace metals, primarily lead, zinc, copper and cadmium. Flow at the mouth of the main portal was gaged at 144 gpm or 0.32 cfs. At the base of the first bench and approximately 110 feet from the mouth of the main portal, the portal flow splits at a spoils dump and load out structure. The main flow is diverted to the north towards a beaver pond. A secondary flow is diverted to the south, commingling with a tailings dump. Much of the flow along this channel appears to be subsurface flow and may exit the site as seepage. Sample AF#1, which was collected from the tailings surface flow (measured at 6.5 gpm) is characterized by an increase in pH relative to the upstream sampling site (AF#6). Trace metals concentrations at this site either remained the same as AF#6 or decreased as a function of the increase in pH and Eh. The lead concentration, however increased significantly (approximately 10 times). This increase appears to be primarily tailings related. Previous sampling by Merritt, 1988 bore out this relationship though at a significantly greater magnitude (160 time increase in lead concentration). Dr. Merritt's sampling took place during a "rain storm" which may have influenced the magnitude of the trace metal concentrations.

A sample (AF#4) was collected at the mouth of the beaver pond prior to commingling with the waters of the North Fork drainage. Sampling data from this point (Figure 4) suggest that the beaver pond is efficiently removing most trace metals from solution. Most of the iron and copper were precipitated out of the waters prior to entrance into the beaver pond. Cadmium and zinc which exhibit similar geochemical behavior were reduced in concentration by approximately 50%. Lead concentrations were below detection limits at the mouth of the beaver pond.

Samples AF#3 and AF#2 were collected from the main stream at sites upstream and downstream of the Pacific Mine disturbance. The waters upstream of the mine disturbance meet all Class 3A standards for aquatic wildlife. Downstream of the mine (AF#2), the waters exceed state criteria for lead. This sample exhibits an impact of the mine discharge in its four-fold increase in zinc. Zinc levels approach the aquatic standard. Studies by Mangum, 1988 indicated that "the number of organisms (macroinvertebrates) had decreased approximately 70% from an upstream to a downstream station in the vicinity of the Pacific Mine."

Figure 5 characterizes the changes in water quality character (major anions and cations) at the Pacific Mine. Trilinear diagrams typically are used to present the relative chemical characteristics of waters collected from different locations. Qualitatively, if two samples or data points plot in the same field on a trilinear diagram a common source of ions is indicated. It is no surprise that the five samples plot within the same field and can be classified as calcium-magnesium bicarbonate waters. Both ground water and surface water sources at this site are strongly influenced by site geology. The portal discharge is more sulfate-rich than the receiving

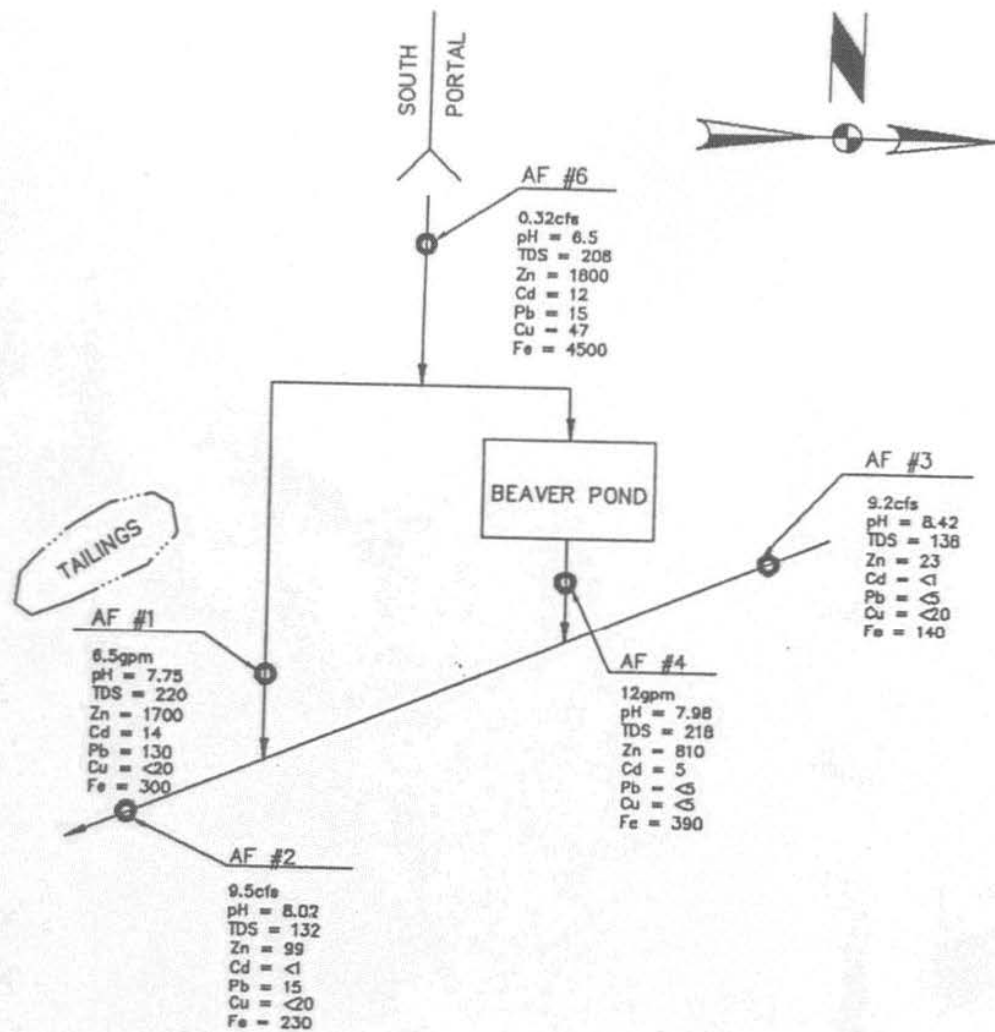


FIGURE 4. PACIFIC MINE SAMPLING PROGRAM

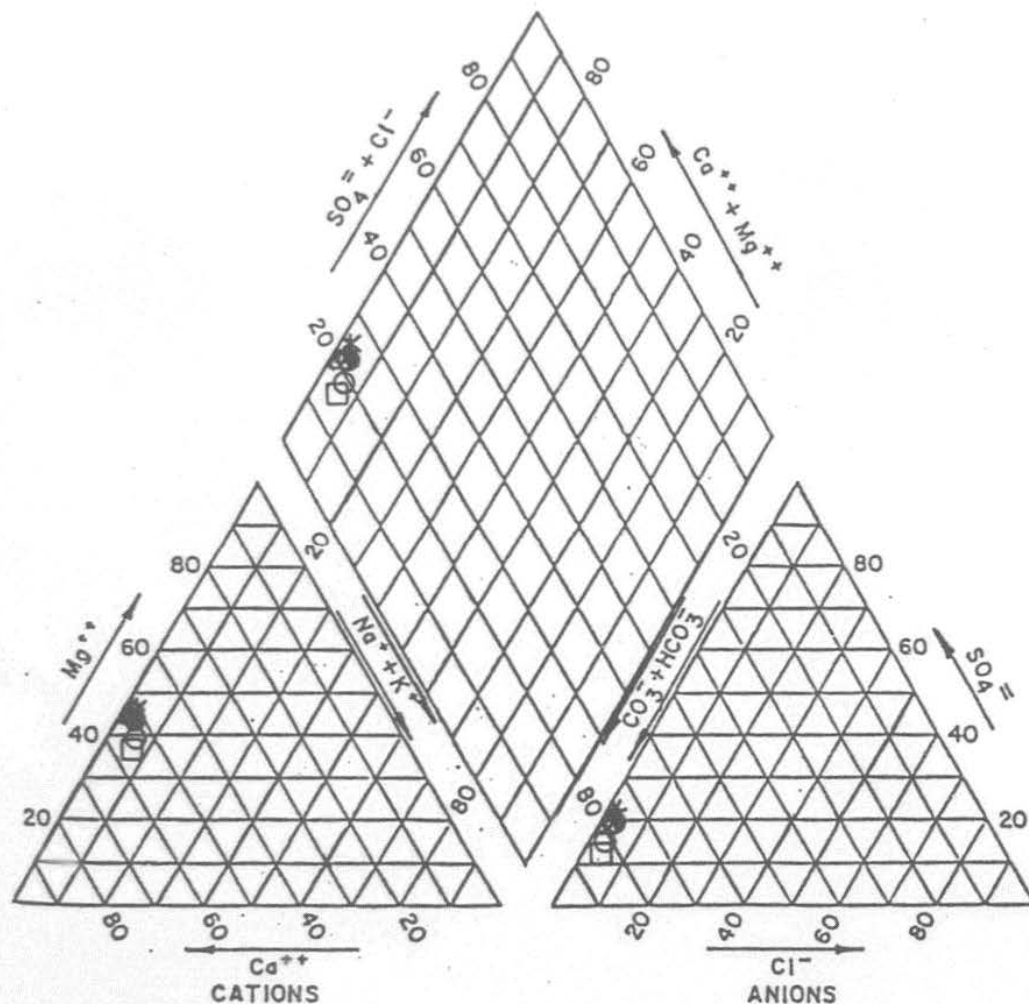


FIGURE 5. TRILINEAR DIAGRAM CHARACTERIZING
THE WATER QUALITY AT PACIFIC MINE

- LEGEND
- △ AF #1
 - AF #2
 - AF #3
 - * AF #4
 - AF #6

waters, yet the relative dilution of the portal discharge by the main streams waters (30:1) result in the "commonality of ions" portrayed on Figure 5. The portal discharge was measured at 0.32 cfs. The North Fork of the American Fork was gaged at 9.2 cfs.

3.3 Mary Ellen Gulch Mines

The Mary Ellen Gulch Mines are located along a south east-flowing tributary drainage to the North Fork of the American Fork at an average elevation of 9,100 feet AMSL. The site consists of a number of mine portals, abandoned structures, sedimentation ponds and detention structures, tailings and waste rock piles and spoil dumps. At the time of the field visit, active mining was ongoing at an adjacent and upstream mine. There was recent evidence of attempts to control the north portal drainage at the Mary Ellen Gulch Mine. Field parameters were collected from two discharging portals: the south portal (pH= 7.2; EC= 205 umhos/cm) and the north portal (pH= 5.95; EC= 180). Since the most significant discharge (70 gpm vs. 2.5 gpm) originates from the north portal, only that portal was sampled (Figure 6). The sampling program at the Mary Ellen Gulch Mines was developed to ascertain the impacts of the AMR portal discharge on the receiving waters, Mary Ellen Gulch. Prior to the initiation of this project it was understood that other abandoned mines and dumps were present in the upper basin, but that the Mary Ellen Gulch north portal may have had the most significant impact on the drainage and the fishery.

On the day the Mary Ellen Gulch Mines were sampled, the Globe Mine, immediately upstream of the AMR site was discharging "milky sediment-laden water". The discharge ceased at approximately 5:30 PM that day. In an attempt to collect the most representative downstream sample, AF#9, was collected at 7:15 PM. Fine sediment, a reflection of the Globe Mine discharge, was present on the stream gravels throughout the downstream reach.

The discharge from the main north portal (AF#7) was acidic (pH=5.95) with "yellow boy" and iron oxide precipitates near the mouth of the portal. The sample data from the 1992 sampling program indicated that the trace metal concentrations of this portal were not very high with only zinc, and iron exceeding aquatic standards. Previous sampling efforts (Merritt, 1988) found that elevated levels of copper, lead and cadmium originated from this portal. A sample collected upstream of the AMR disturbance and along Mary Ellen Gulch, AF#8, is characterized by good water quality. Class 3A aquatic standards were achieved for all parameters. The downstream sample, AF#9, may have been influenced by the discharges from the active underground mine above the AF#7 sampling location. Despite any such influence the 1992 sample analysis was very similar to the previous sample analysis by Merritt, 1988 which exhibited elevated concentrations of zinc, iron, copper and lead. Copper and lead appear to originate from some source other than the mine portal and may be related to the upstream Globe Mine or possibly to adjacent spoils and tailings dumps within the Mary Ellen Gulch basin.

A trilinear diagram (Figure 7) characterizes the transitional change in water quality character (major anions and cations) at the Mary Ellen Gulch Mines. The waters discharging from the portal (AF#7) are calcium- magnesium sulfate waters. The waters of Mary Ellen Gulch prior to "mixing" (AF#8) are calcium- magnesium bicarbonate type waters. Once these waters are mixed (AF#9) at the dilution ratio naturally occurring on-site (10:1) the waters change

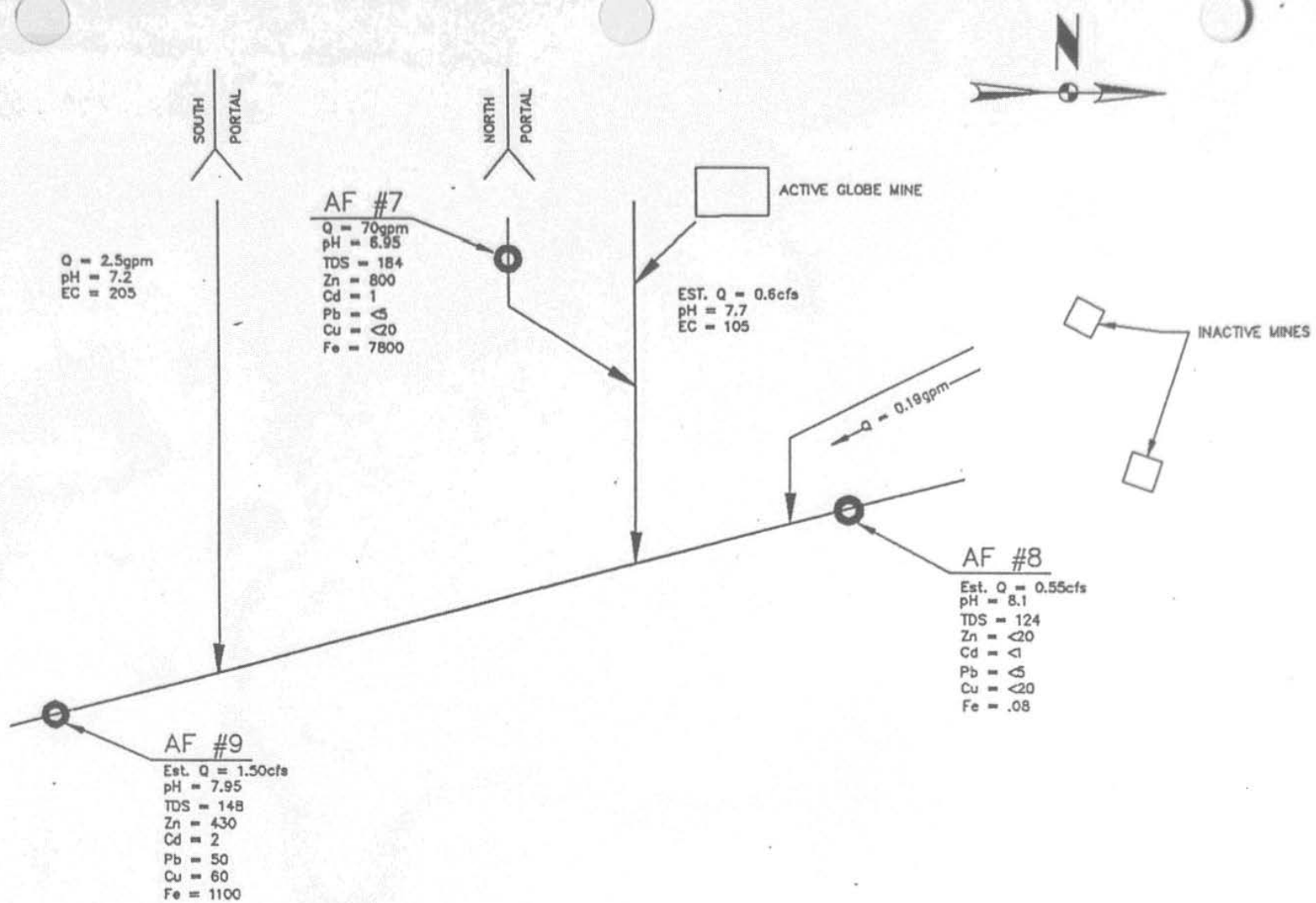


FIGURE 6. MARY ELLEN GULCH SAMPLING PROGRAM

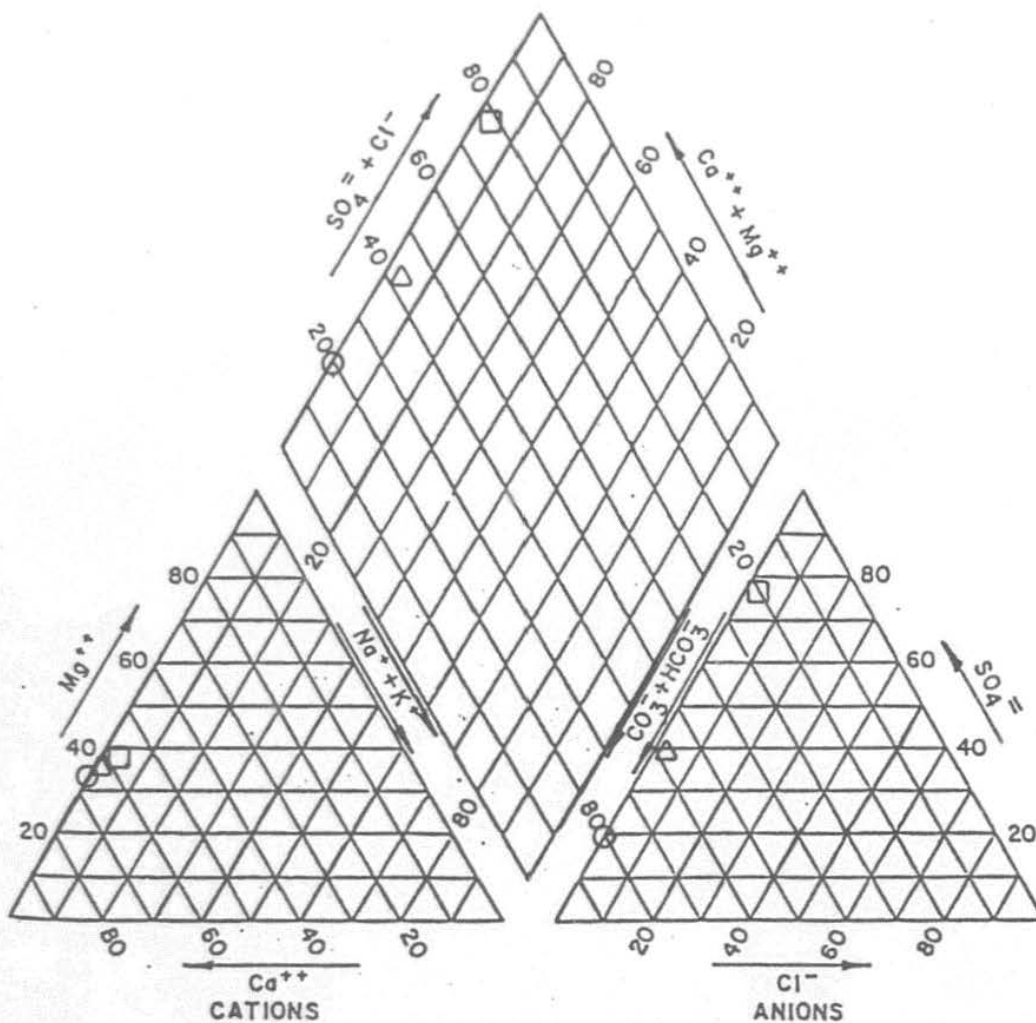


FIGURE 7. TRILINEAR DIAGRAM CHARACTERIZING
THE WATER QUALITY AT MARY ELLEN GULCH

LEGEND □ AF #7
 ○ AF #8
 △ AF #9

chemistry to a calcium magnesium sulfate-bicarbonate- type water. The portal discharge was measured at 70 gpm. The main stem of Mary Ellen Gulch was gaged at 1.50 cfs.

4.0 Water Quality Impacts to the North Fork of the American Fork

4.1 Site Geochemistry

It is important to understand the geochemical changes, which occur as the mine discharge water exits the mine portals and before it enters the main stream. In general the water quality exiting the mine portals (Figure 8) is a calcium- magnesium sulfate-type water. The Pacific Mine drainage is predominantly calcium-magnesium bicarbonate water. The drainage from these portals are typically high in cadmium, copper, lead, iron and zinc. The anomalous concentrations of trace metals in the waters exiting these mine portals are directly related to the trace element geochemistry of the ore zones (Chapter 2.1). Copper and iron concentrations in water are strongly Eh and pH dependent. In the case of the mine portal discharge the majority of the iron precipitates out of solution as the waters become oxidized and the pH increases to neutral. The copper coprecipitates as a copper carbonate and is removed from the solution as Eh increases.

The trace metals zinc, cadmium and lead are somewhat more problematical since they are mobile under a wider range of Eh and pH conditions. Lead is the least mobile of these latter three elements and its solubility under oxidizing conditions is controlled by the presence of the carbonate ion and to a lesser degree, the sulfate ion. Under reducing conditions, lead will precipitate as a sulfide. Lead concentrations in the waters at the American Fork mines do not appear to be directly related to discharge from the mine portals but rather to contact with an outside source, either the tailings at the Pacific Mine or an adjacent upstream mine source, such as the Globe Mine within Mary Ellen Gulch.

Cadmium and zinc have similar geochemical behavior and are mobile under oxidizing conditions and nearly all pH conditions present at the American Fork sites. Cadmium levels are relatively low at the source and appear to rapidly decrease with dilution and to a certain degree by plant uptake. Chelation and/or adsorption of cadmium by organic matter in the beaver pond at the Pacific Mine appears to have a positive impact on trace metal concentration. Further discussion of these processes can be found in Kastning-Culp, et.al. 1992. The high concentrations of zinc are the most serious trace metal water quality problem in the American Fork Canyon. Zinc concentrations remain elevated at all stations sampled. Dilution of the portal discharge by the main channel flow appears to be the most significant mechanism for the reduction of zinc concentrations. Plant uptake of zinc, adsorption of zinc on hydrous manganese and iron oxides, adsorption and chelation of zinc by organic matter in the beaver pond at the Pacific Mine currently reduce concentrations of zinc in the effluent waters. Over time reducing conditions will develop within the beaver pond, accelerating the process of zinc removal as zinc sulfide precipitate. The limiting factor for sulfide precipitation at all American Fork sites is the degree of sulfate present in the water. With the exception of the Lower Bog site, nearly all project "receiving waters" are carbonate-rich.

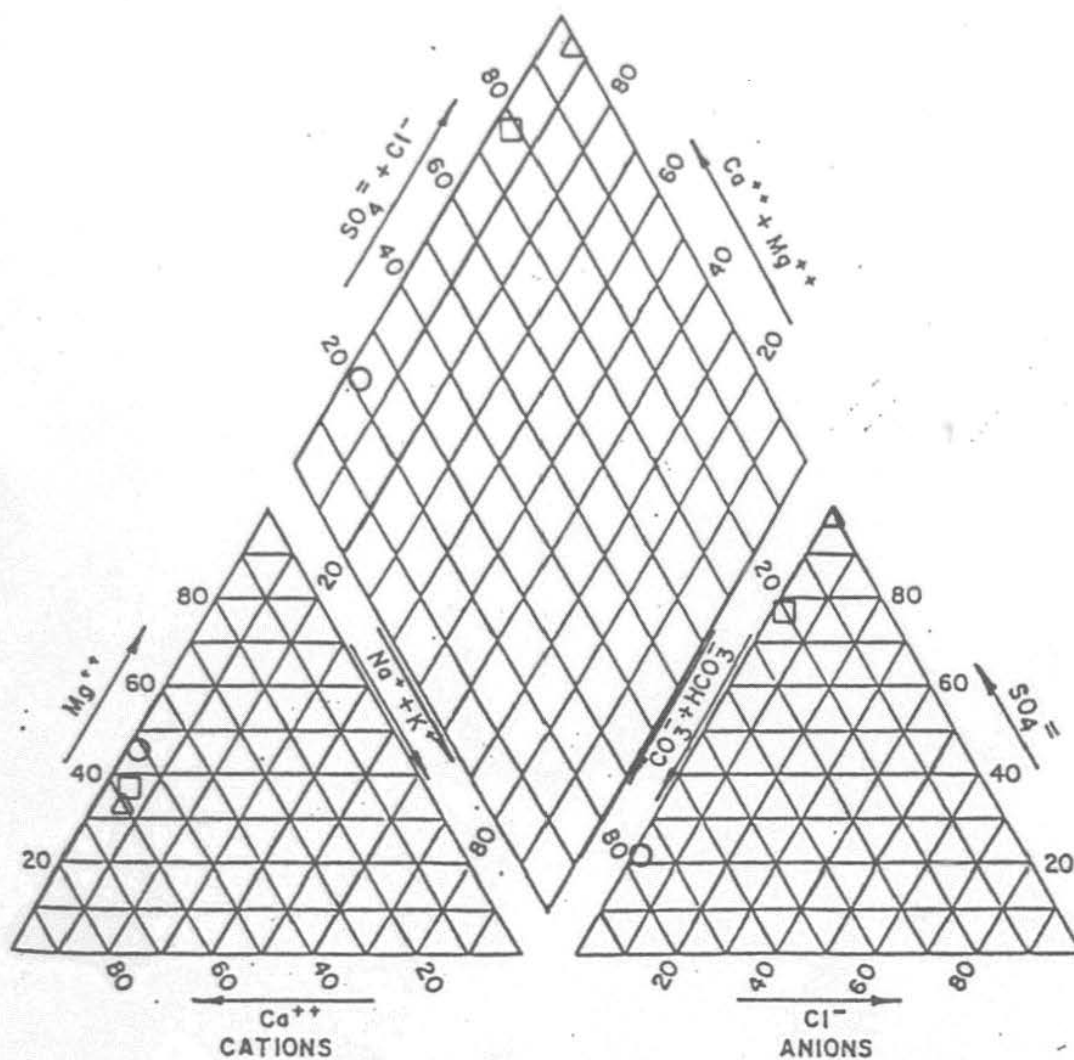


FIGURE 8. TRILINEAR DIAGRAM CHARACTERIZING
THE WATER QUALITY AT MINE PORTALS

LEGEND \triangle AF #5
 \square AF #7
 \circ AF #6

it was felt to be most applicable to this project because past mining in the American Fork Canyon and current field observations suggest that the 1992 sampled water quality reflects a long term average condition.

Table 2 presents a summary of the American Fork water quality sampling program in relationship to the four-day average aquatic standard. On a site by site basis, samples AF#2 and AF#9 reflect the water quality at locations downstream of the disturbance and within the receiving waters, the American Fork and Mary Ellen Creek. No downstream sample was collected below the Lower Bog Mine. Previous sampling efforts by Mangum, 1988 document the zinc concentrations above and below the Lower Bog Mine.

Sample AF#2 (Table 2 and Figure 4) was collected approximately 800 feet below the Pacific Mine and exceeds aquatic fisheries standards for lead by a factor of four (4). Zinc concentrations at the downstream sample are slightly below the Aquatic Class 3A standards, yet are significantly elevated (four times) above background or upstream water quality. It is anticipated that zinc concentrations downstream of the Pacific Mine will exceed Class 3A water quality during certain periods of the year. The principal source of the elevated lead concentration at the Pacific Mine is the tailings dump adjacent to the North Fork of the American Fork. The principal source of the elevated zinc concentration is the water discharging from the south portal of the Pacific Mine. Based on the impacts of the Pacific Mine on the receiving water quality, remedial action at this site is recommended.

Sample AF#9 (Table 2 and Figure 6) characterizes the downstream water quality of Mary Ellen Gulch below the Mary Ellen Gulch Mine. This sample exceeds Class 3A water quality standards for cadmium, copper, iron, lead and zinc. Of these parameters, copper, lead and zinc are of primary concern. Copper exceeds standards by a factor of 4.5; lead exceeds standards by a factor of 13.2; zinc exceeds standards by a factor of 3.6. All parameters are significantly elevated above the upstream water quality sample AF#8. An insufficient number of samples were collected at this site to fully characterize the source of the trace metal contamination of Mary Ellen Gulch. The upstream sample, AF#8, eliminates the abandoned Yankee Mines (Figure 1) as a source of the metal contamination. Sample AF#7 was collected from the

Table 2. Water Quality Samples Which Exceed Class 3A Aquatic Fisheries Standards (4-Day Average).

Aquatic Standard*		Sample Concentration								
	4-Day	AF#1	AF#2	AF#3	AF#4	AF#5	AF#6	AF#7	AF#8	AF#9
pH	6.5-9.0 su	--	--	--	--	3.9	--	6.0	--	--
As	190 µg/l	--	--	--	--	--	--	--	--	--
Cd	1.3 µg/l	14	--	--	5	14	12	--	--	2
Cu	13.3 µg/l	--	--	--	--	30	47	--	--	60
Fe	1000 µg/l	--	--	--	--	9100	4500	7800	--	1100
Pb	3.8 µg/l	130	15	--	--	10	15	--	--	50
Se	5 µg/l	--	--	--	--	--	--	--	--	--
Zn	119 µg/l	1700	--	--	810	660	1800	800	--	430

* Hardness dependent criteria (pertaining to Cd, Cr, Cu, Pb, and Zn) assumes 115 mg/l total hardness

discharge waters of the Mary Ellen Gulch North Portal. Although cadmium and zinc were elevated at this source, only zinc exceeded Class 3A standards. It appears that an adjacent source must contribute toxic levels of trace metals, in particular lead and copper. That source could be the upstream and active Globe Mine or possibly runoff from the Mary Ellen Gulch tailings or the abandoned Mary Ellen Gulch South Portal. Before any mine reclamation can proceed at this site, additional water and soil sampling is necessary to clearly define the source of the contamination and maximize the positive effects of the reclamation.

No 1992 downstream sample was collected at the Lower Bog Mine site. Field parameters (Table 1) collected upstream and downstream of the mine discharge and along the North Fork of the American Fork suggest that there is minimal impact to the receiving waters (pH and TDS). Sampling of the discharging waters from the Lower Bog portal suggest that the waters exiting the mine portal reflect poor water quality, exceeding Class 3A standards (Table 2) for pH, cadmium, iron, copper, lead and zinc. With the exception of pH and iron, the metals concentration of the Lower Bog Mine portal (AF#5) is less than the Pacific Mine portal (AF#6). When comparing the dilution ratio (receiving water flow to the portal discharge) it is apparent that there is greater dilution at the Lower Bog Mine than at the Pacific Mine. Assuming similar geochemical conditions, one can predict that the impact of the Lower Bog Mine discharge on the American Fork River will be less than the impact of the Pacific Mine discharge. The principal contaminants of interest will be zinc and possibly lead. Sampling conducted in 1988 (Mangum, 1988) indicated that zinc concentration will exceed Class 3A standards during the low water period of the year by a factor of 1.6. Because of the site's inaccessibility and the limited magnitude of the problem, no action is recommended at the Lower Bog Mine site.

4.3 Proposed Mine Reclamation

The 1992 water quality investigations quantified the environmental impacts of the AMR disturbances on the North Fork of the American Fork. Additional study is recommended at the Mary Ellen Gulch sites. No further action is recommended at the Lower Bog Mine. Sufficient water quality data are available at the Pacific Mine to document the nature and magnitude of the environmental problem at this site. AMR and/or USFS action is recommended at this site to mitigate the adverse impacts of past mining activities.

Available funding, land and mineral owner consent and final land use may restrict the degree of mine reclamation and ultimately its success in the mitigation of adverse impacts. On this basis a phased approach is recommended. Two interrelated sources of contamination will have to be addressed at the Pacific Mine: (1) portal discharge and (2) the tailings pond adjacent to the creek.

The primary source of contamination, the tailings dump is responsible for the elevated lead levels in the American Fork at sample site AF#2. Lead concentrations are transported to the creek via mine portal discharge as surface and subsurface flow, overland flow in response to rainfall and snowmelt events and bank erosion and channel migration of the American Fork against the tailings embankment. This study did not quantify the relative metals loading of each mechanism of transport.

The tailings dump should be isolated from the American Fork through a combination of cut and fill, rerouting of the portal discharge drainage and revetment of the existing American Fork channel banks. All portal discharges should be routed in a permanent diversion channel directly to the beaver pond. Because of the steep gradient of this channel, riprap protection will be required. The riprap will serve a multiple purpose of protecting the permanent diversion from erosion, oxidizing the discharging portal waters, raising the pH of the waters and coprecipitating the iron from solution, as well as serving as a permanent and maintenance-free barrier to ATV traffic attempting to access the tailings dump site. On site limestone or dolomitic rock can be utilized as riprap. Screening and sorting of this rock will be required to ensure a well graded riprap blanket.

The east slope of the tailings dump should be excavated from the vicinity of the North Fork of the American Fork channel. These materials should be transported to the top of the tailings dump and regraded to a "domed", yet relatively flat (less than 3% grade) surface. Ponded areas on the existing tailings dump should be eliminated. The outslope (east) of the regraded tailings dump should be graded to no steeper than a 4:1. The regraded surface of the tailings should be "deep ripped and limed" to elevate the pH of the tailings above 6.5. Topsoil can be borrowed from adjacent sites and placed on the regraded and limed surface. A minimum of 12 to 15 inches of topsoil should be placed on site. Care should be taken to separate A and B horizon material at the borrow site to ensure that an organic rich layer of A-horizon material is available for final cover. This same material will serve as a natural seed source and will reduce revegetation costs. The site should be broadcast seeded and harrowed. A riprap bank apron or at a minimum, toe slope riprap protection should be placed along the outslope, adjacent to the creek. Depending on the characteristics of available rock, this riprap may have to be imported to the site. Wooden cribs or similar biotechnical slope protection may be substituted for riprap. However longevity of the design should be addressed.

Additional treatment of the discharging portal waters can be accomplished through the construction of a wetland on the upper terrace immediately above the beaver pond. The purpose of this wetland is to accomplish primary treatment of zinc and cadmium, prior to the water's entrance into the beaver pond. The beaver pond would behave as a secondary treatment facility. The wetland would be excavated into the surface adjacent to the "loadout" area. Approximately 4,000 square feet of surface is available for wetland construction. An impermeable liner and coarse limestone gravels would be placed at the bottom of the excavation. Organic matter (humus, manure, soils borrowed from the beaver pond area) would be backfilled above the gravel layer. The site would be topsoiled and planted with the appropriate locally available vegetation. Kastning-Culp, 1992 documents the chelation properties and plant uptake of zinc by local vegetative species. Soil and moss berms would be constructed within the wetland to prevent short-circuiting of the influent waters. The wetland would discharge directly to a ditch, which would flow to the beaver pond and ultimately to the North Fork of the American Fork.

Under a phased approach, the initial reclamation should entail a channel diversion of all portal discharges to the beaver pond. "Follow-up" water quality sampling should take place to evaluate the beaver pond's ability to treat the additional waters. Later phases should include the limited cut and fill and regrading of the tailings dump, channel stabilization of the North Fork in the vicinity of the tailings dump and the construction of the wetland.

A conceptual design of the Pacific Mine proposed reclamation is presented on Figure 9. Surveying and mapping should be completed prior to the finalization of the designs. The design process should include an evaluation of design hydrology, channel hydraulics, soils and vegetation requirements, final earthwork, preparation of final plans and specifications.

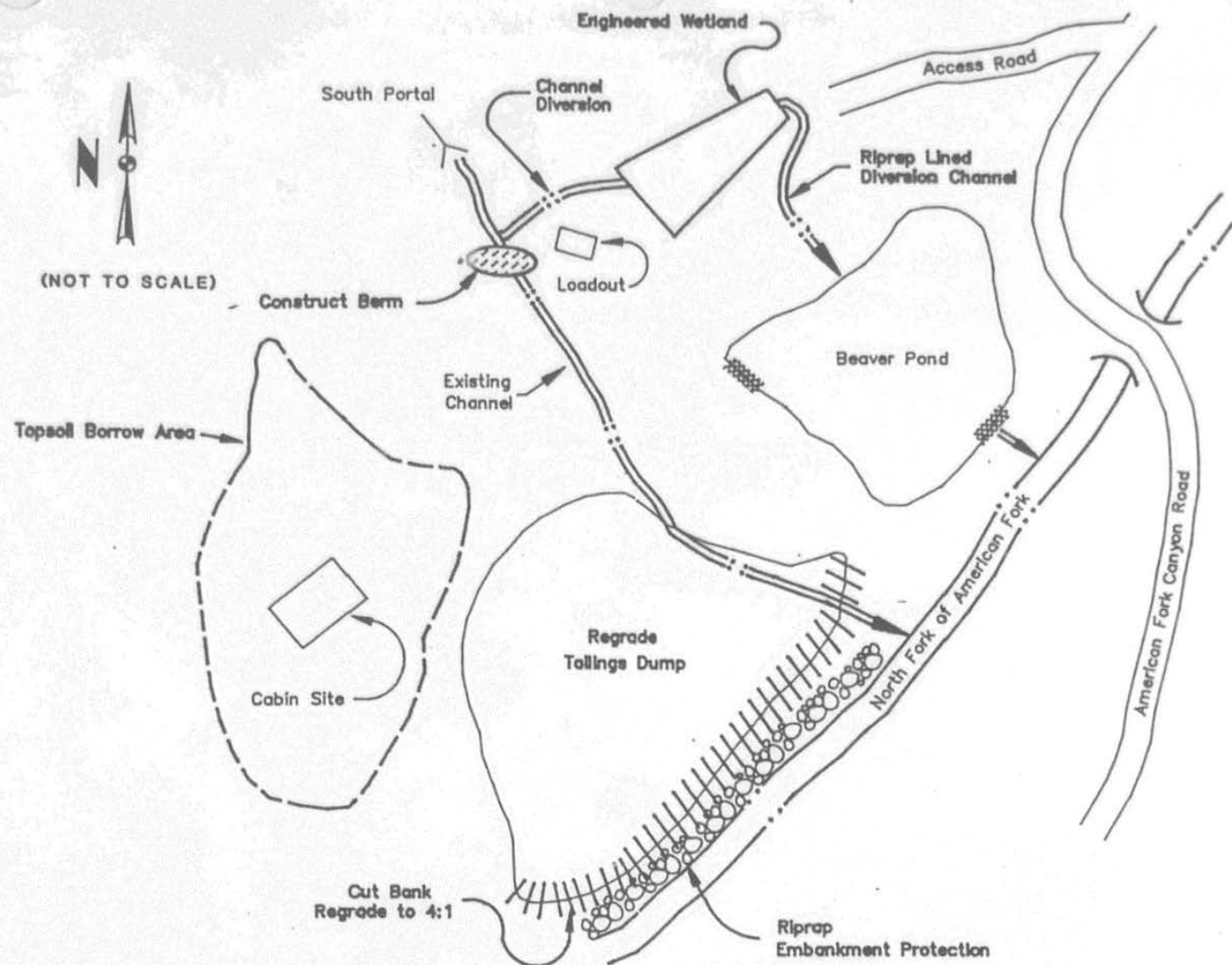
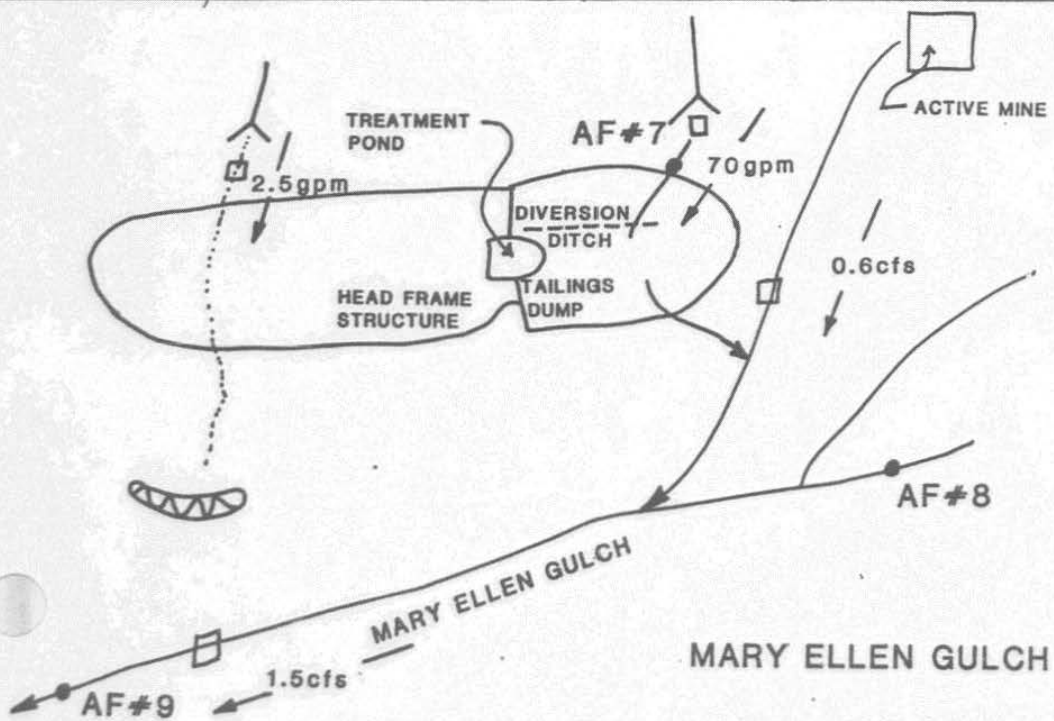
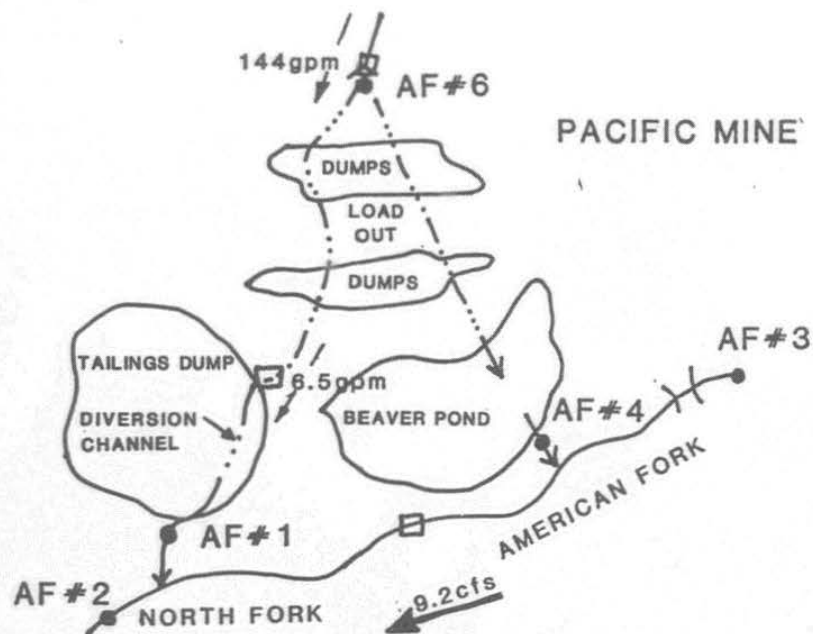


FIGURE 9. CONCEPTUAL DESIGN OF RECLAMATION AT THE PACIFIC MINE

APPENDIX A
WATER QUALITY DATA



Pacific Mine seepage above confluence
w/ American Fork

pH = 7.75
temp. = 18.3
EC = 325
color = clear

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description: AMERICAN FORK #1		
Site ID:	Source: 00	<u>Date of Review and QA Validation</u>
Cost Code: 350B		Inorganic Review: 92/07/29
Lab Number: 9204265	Type: 04	Organic Review:
Sample Date: 92/07/08	Time: 12:45	Radiochemistry Review:
Tot. Cations: 68		Microbiology Review:
Tot. Anions: 140 mg/l	Cations: 4.1 me/l	
Grand Total: 208 mg/l	Anions: 4.2 me/l	

Laboratory Analyses

L-pH *	7.9	D-Calcium	43 mg/l
D-Magnesium	23 mg/l	D-Potassium	<1 mg/l
Bicarbonate	206 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	38.045 mg/l
Tot. Alk.	169 mg/l	TDS @ 180C	220 mg/l
H+Arsenic	5.0 ug/l	H+Barium	0.11 mg/l
H+Cadmium	14 ug/l	H+Chromium	<5.0 ug/l
H+Copper	<20.0 ug/l	H+Iron	0.3 mg/l
H+Lead	130.0 ug/l	H+Mangan	92.0 ug/l
H+Selenium	<5.0 ug/l	H+Zinc	1700.0 ug/l

PH pH should be performed as a field test.

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AMERICAN FORK #2

North Fork of American Fork below
Pacific Mine

pH = 8.05
temp = 13.3
EC = 170
color = clear

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description:	AMERICAN FORK #2		
Site ID:		Source:	00
Cost Code:	3508		<u>Date of Review and QA Validation</u>
Lab Number:	9204266	Type:	04
Sample Date:	92/07/08	Time:	13:05
Tot. Cations:	42		Inorganic Review: 92/07/29
Tot. Anions:	80 mg/l	Cations:	2.5 me/l
Grand Total:	122 mg/l	Anions:	2.5 me/l
			Organic Review:
			Radiochemistry Review:
			Microbiology Review:

Laboratory Analyses

L-pH *	8.0	D-Calcium	28 mg/l
D-Magnesium	12 mg/l	D-Potassium	<1 mg/l
Bicarbonate	128 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	15.889 mg/l
Tot. Alk.	105 mg/l	TDS @ 180C	132 mg/l
H-Arsenic	<5.0 ug/l	H-Barium	0.053 mg/l
H-Cadmium	<1 ug/l	H-Chromium	<5.0 ug/l
H-Copper	<20.0 ug/l	H-Iron	0.23 mg/l
H-Lead	15.0 ug/l	H-Mangan	21.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	99.0 ug/l

PH pH should be performed as a field test.

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OIL GAS & MINING

AMERICAN FORK #3

N. Fork of American Fork above
Pacific Mine

pH = 8.42
temp = 11.3
EC = 150
Color = clear

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description: AMERICAN FORK #3

Site ID: Source: 00

Cost Code: 350B

Lab Number: 9204267 Type: 04

Sample Date: 92/07/08 Time: 12:30

Tot. Cations: 39

Tot. Anions: 77 mg/l

Grand Total: 116 mg/l

Cations: 2.3 me/l

Anions: 2.3 me/l

Date of Review and QA Validation

Inorganic Review: 92/07/29

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

L-pH *	7.9	D-Calcium	26 mg/l
D-Magnesium	11 mg/l	D-Potassium	<1 mg/l
Bicarbonate	119 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	17.572 mg/l
Tot. Alk.	97 mg/l	TDS @ 180C	138 mg/l
H-Arsenic	<5.0 ug/l	H-Barium	0.043 mg/l
H-Cadmium	<1 ug/l	H-Chromium	<5.0 ug/l
H-Copper	<20.0 ug/l	H-Iron	0.14 mg/l
H-Lead	<5.0 ug/l	H-Mangan	16.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	23.0 ug/l

PH pH should be performed as a field test.

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OIL GAS & MINING

AMERICAN FORK #4

Seepage Discharge from Beaver Pond
above confluence of American Fork

pH. = 7.98
temp. = 11.7
EC = 280
color = clear

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description: AMERICAN FORK #4

Site ID: Source: 00

Cost Code: 3508

Lab Number: 9204268 Type: 04

Sample Date: 92/07/08 Time: 12:15

Tot. Cations: 68

Tot. Anions: 136 mg/l

Grand Total: 204 mg/l

Date of Review and QA Validation

Inorganic Review: 92/07/29

Organic Review:

Radiochemistry Review:

Microbiology Review:

Cations: 4.1 me/l

Anions: 4.1 me/l

Laboratory Analyses

L-pH *	7.7	D-Calcium	42 mg/l
D-Magnesium	23 mg/l	D-Potassium	<1 mg/l
Bicarbonate	202 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	35.646 mg/l
Tot. Alk.	165 mg/l	TDS @ 180C	218 mg/l
H-Arsenic	<5.0 ug/l	H-Barium	0.086 mg/l
H-Cadmium	5 ug/l	H-Chromium	<5.0 ug/l
H-Copper	<20.0 ug/l	H-Iron	0.39 mg/l
H-Lead	<5.0 ug/l	H-Mangan	18.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	810.0 ug/l

PH pH should be performed as a field test.

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OIL GAS & MINING

AMERICAN FORK #6

Seepage from Pacific Mine @ Portal

pH. = 6.54

temp. = 7.8

EC = 230

color = sl. Cloudy,
red, Fe ppt

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description:	AMERICAN FORK #6		
Site ID:		Source:	00
Cost Code:	3508		
Lab Number:	9204270	Type:	04
Sample Date:	92/07/08	Time:	15:30
Tot. Cations:	65		
Tot. Anions:	135 mg/l	Cations:	3.9 me/l
Grand Total:	200 mg/l	Anions:	4.0 me/l

Date of Review and QA Validation
Inorganic Review: 92/07/29
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

L-pH *	6.9	D-Calcium	40 mg/l
D-Magnesium	22 mg/l	D-Potassium	<1 mg/l
Bicarbonate	191 mg/l	Carbonate	0 mg/l
Chloride	1.4 mg/l	Sulfate	39.473 mg/l
Tot. Alk.	156 mg/l	TDS @ 180C	208 mg/l
H-Arsenic	20.0 ug/l	H-Barium	0.084 mg/l
H-Cadmium	12 ug/l	H-Chromium	<5.0 ug/l
H-Copper	47.0 ug/l	H-Iron	4.5 mg/l
H-Lead	15.0 ug/l	H-Mangan	15.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	1800.0 ug/l

PH pH should be performed as a field test.

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AMERICAN FORK #7

North Portal Mary Ellen Guich

pH. = 5.95

temp. = 8.0

EC = 180

Color = clear, Feppt

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description: AMERICAN FORK #7

Site ID: Source: 00

Cost Code: 350B

Lab Number: 9204271 Type: 04

Sample Date: 92/07/08 Time: 17:05

Tot. Cations: 44

Tot. Anions: 118 mg/l

Grand Total: 162 mg/l

Date of Review and QA Validation

Inorganic Review: 92/08/06

Organic Review:

Radiochemistry Review:

Microbiology Review:

Cations: 2.6 me/l

Anions: 2.7 me/l

Laboratory Analyses

L-pH *	6.0	D-Calcium	30 mg/l
D-Magnesium	12 mg/l	D-Potassium	1.2 mg/l
Bicarbonate	30 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	102.13 mg/l
Tot. Alk.	25 mg/l	TDS @ 180C	184 mg/l
H-Arsenic	70.0 ug/l	H-Barium	0.014 mg/l
H-Cadmium	1 ug/l	H-Chromium	<5.0 ug/l
H-Copper	<20.0 ug/l	H-Iron	7.8 mg/l
H-Lead	<5.0 ug/l	H-Mangan	210.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	800.0 ug/l

PH pH should be performed as a field test.

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AUG 10 1992

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AMERICAN FORK #8

Mary Ellen Gulch above AML disturbance
pH. = 8.1
temp. = 9.1
EC = 140
color = clear

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description:	AMERICAN FORK #8		
Site ID:	Source:	00	Date of Review and QA Validation
Cost Code:	3508		Inorganic Review: 92/07/29
Lab Number:	9204272	Type: 04	Organic Review:
Sample Date:	92/07/08	Time: 17:50	Radiochemistry Review:
Tot. Cations:	37		Microbiology Review:
Tot. Anions:	73 mg/l	Cations:	2.1 me/l
Grand Total:	110 mg/l	Anions:	2.2 me/l

Laboratory Analyses

L-pH *	8.0	D-Calcium	25 mg/l
D-Magnesium	10 mg/l	D-Potassium	<1 mg/l
Bicarbonate	106 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	19.91 mg/l
Tot. Alk.	87 mg/l	TDS @ 180C	124 mg/l
H-Arsenic	<5.0 ug/l	H-Barium	0.044 mg/l
H-Cadmium	<1 ug/l	H-Chromium	<5.0 ug/l
H-Copper	<20.0 ug/l	H-Iron	0.08 mg/l
H-Lead	<5.0 ug/l	H-Mangan	<5.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	<20.0 ug/l

PH pH should be performed as a field test.

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OIL GAS & MINING

AMERICAN FORK #9

Mary Ellen Gulch below AML disturbnc
pH. = 7.95
temp. = 10.4
EC = 170
Color = milky

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description:	AMERICAN FORK #9		
Site ID:		Source:	00
Cost Code:	350B		
Lab Number:	9204273	Type:	04
Sample Date:	92/07/08	Time:	19:15
Tot. Cations:	43		
Tot. Anions:	97 mg/l	Cations:	2.5 me/l
Grand Total:	140 mg/l	Anions:	2.6 me/l

Date of Review and QA Validation
Inorganic Review: 92/07/29
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

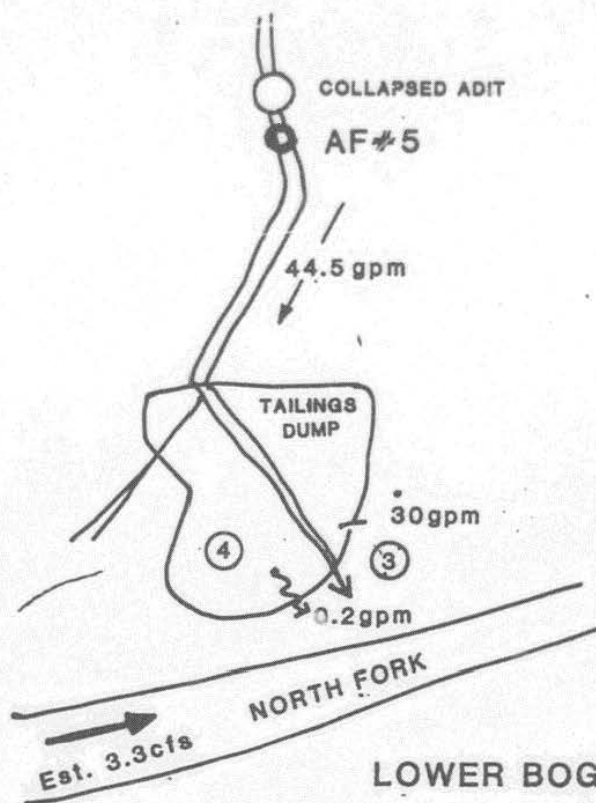
L-pH *	7.9	D-Calcium	29 mg/l
D-Magnesium	12 mg/l	D-Potassium	<1 mg/l
Bicarbonate	94 mg/l	Carbonate	0 mg/l
Chloride	<1 mg/l	Sulfate	49.504 mg/l
Tot. Alk.	77 mg/l	TDS @ 180C	148 mg/l
H-Arsenic	10.0 ug/l	H-Barium	0.034 mg/l
H-Cadmium	2 ug/l	H-Chromium	<5.0 ug/l
H-Copper	60.0 ug/l	H-Iron	1.1 mg/l
H-Lead	50.0 ug/l	H-Mangan	60.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	430.0 ug/l

PH pH should be performed as a field test.

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OIL GAS & MINING



Description: AMERICAN FORK #5

Site ID: Source: 00

Cost Code: 3508

Lab Number: 9204269 Type: 04

Sample Date: 92/07/08 Time: 14:25

Tot. Cations: 17

Tot. Anions: 66 mg/l

Grand Total: 83 mg/l

Date of Review and QA Validation

Inorganic Review: 92/07/29

Organic Review:

Radiochemistry Review:

Microbiology Review:

Cations: 0.9 me/l

Anions: 1.4 me/l

Laboratory Analyses

L-pH "	3.9	D-Calcium	11 mg/l
D-Magnesium	3.6 mg/l	D-Potassium	1.1 mg/l
Bicarbonate	0 mg/l	Carbonate	0 mg/l
Chloride	1.4 mg/l	Sulfate	64.368 mg/l
Tot. Alk.	0 mg/l	TDS @ 180C	120 mg/l
H+Arsenic	<5.0 ug/l	H+Barium	0.035 mg/l
H+Cadmium	14 ug/l	H+Chromium	<5.0 ug/l
H+Copper	30.0 ug/l	H+Iron	9.1 mg/l
H+Lead	10.0 ug/l	H+Mangan	290.0 ug/l
H+Selenium	<5.0 ug/l	H+Zinc	660.0 ug/l

AMERICAN FORK #5

Lower Bog portal discharge

pH. = 5.11

TDS = 80 ppm

temp = 10.1

Color = clear, Fe ppt

UTAH STATE HEALTH DEPARTMENT
DIVISION OF LABORATORY SERVICES
Environmental Chemistry Analysis Report

Description: AMERICAN FORK #5
Site ID: Source: 00 Date of Review and QA Validation
Cost Code: 3508 Inorganic Review: 92/07/29
Lab Number: 9204269 Type: 04 Organic Review:
Sample Date: 92/07/08 Time: 14:25 Radiochemistry Review:
Tot. Cations: 17 Microbiology Review:
Tot. Anions: 66 mg/l Cations: 0.9 me/l
Grand Total: 83 mg/l Anions: 1.4 me/l

Laboratory Analyses

L-pH *	3.9	D-Calcium	11 mg/l
D-Magnesium	3.6 mg/l	D-Potassium	1.1 mg/l
Bicarbonate	0 mg/l	Carbonate	0 mg/l
Chloride	1.4 mg/l	Sulfate	64.368 mg/l
Tot. Alk.	0 mg/l	TDS @ 180C	120 mg/l
H-Arsenic	<5.0 ug/l	H-Barium	0.035 mg/l
H-Cadmium	14 ug/l	H-Chromium	<5.0 ug/l
H-Copper	30.0 ug/l	H-Iron	9.1 mg/l
H-Lead	10.0 ug/l	H-Mangan	290.0 ug/l
H-Selenium	<5.0 ug/l	H-Zinc	660.0 ug/l

PH pH should be performed as a field test.

RECEIVED

JUL 31 1992

DIVISION OF
OIL GAS & MINING

APPENDIX B
GAGING DATA


DISCHARGE MEASUREMENT NOTES

LOCATION N. Fork American Fork Ab. Pacific Mine DischargeDATE 7/8/92 PARTY Lidstone/MeschEQUIPMENT Pygmy METHOD _____ WEATHER cloudy/overcastCROSS SECTION GS #1 FLOW clear rapidINITIAL GAGE READING/TIME 10:05 AM FINAL GAGE READING/TIME 10:40 AMCOMMENTS LB looking DS = 0.00. Bed material 2-4" cobbles, some gravels -channel banks overgrown with semi dense overstoryMannings "n" over channel length 0.045 - 0.050; OB = 0.065

Distance From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth @0.6	Revolutions	Time In Seconds	Velocity (ft/s)		Area (ft ²)	Discharge (cfs)
						At Point	Mean		
LB EOW	0.0	0.0	0.0	-----					
							0.79	0.36	0.28
	2.2	0.33		47	30	1.57			
							2.05	0.36	0.74
	3.0	0.58		76	30	2.52			
							2.73	0.67	1.83
	4.0	0.75		44	15	2.93			
							2.55	0.73	1.86
	5.0	0.71		32	15	2.16			
							2.46	0.73	1.80
	6.0	0.75		41	15	2.76			
							2.19	0.71	1.55
	7.0	0.67		24	15	1.62			
							1.31	0.59	0.77
	8.0	0.50		30	30	0.99			
							0.86	0.31	0.27
	8.7	0.42		22	30	0.72			
							0.36	0.27	0.10
	10.0	0.0		0	0	0.00			
									9.2 cfs



Lidstone & Anderson
Water Resources and Environmental Consultant



AQUATIC ECOSYSTEM INVENTORY

Macroinvertebrate Analysis

Annual Progress Report

NORTH FORK AMERICAN FORK RIVER AND

MARY ELLEN GULCH CREEK

UINTA NATIONAL FOREST

1988



Forest Service
Intermountain Region

89-12

AQUATIC ECOSYSTEM INVENTORY
Macroinvertebrate Analysis

NORTH FORK AMERICAN FORK RIVER AND MARY ELLEN GULCH CREEK
UINTA NATIONAL FOREST
1988

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89-12- MAR

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AQUATIC ECOSYSTEM ANALYSIS
FOR NORTH FORK AMERICAN FORK RIVER AND MARY ELLEN GULCH CREEK ON THE
UINTA NATIONAL FOREST

1988

BACKGROUND AND METHODS

In recent years land managers on many of our forests and BLM districts in the west have improved the stability and reliability of land management plans and decisions by sampling aquatic organisms which act as natural monitors of management activities within the drainages on public lands.

During short-term exposure to water of poor quality or adverse changes in habitat, organisms that cannot tolerate the stress are destroyed and the aquatic macroinvertebrate community structure changes. Since aquatic organisms respond to their total environment, they can become an effective tool for detection of environmental changes.

Our analysis of aquatic ecosystems is based upon multiple factors including:

1. Various macroinvertebrate data - Community dry-weight biomass/sample expressed in gm/m^2 ; number of individuals per taxa (resident populations?); DAT Diversity Index, which combines a measure of dominance and number of taxa; habit, habitat and feeding preferences of individual taxa or species; specific tolerances of taxa; community composition; and BCI (Biotic Condition Index), which indicates as a percentage how close an aquatic ecosystem is to its own potential.

2. Physical parameter data and

3. Water chemistry data

Effective use of the Biotic Condition Index (BCI) depends upon the availability of data on stream gradient, natural capability of instream substrate (may not be the composition present if man-influence' sedimentation is found at the sample station), total alkalinity, and sulfate in mg/l .

Because of the way that macroinvertebrates occupy space within a stream, it generally takes at least three samples to represent the community accurately at a given station. One sample per station costs less but has little value for aquatic habitat assessment, one never knows if such single samples represent the best, the worst or an average of possible conditions at the sampling site. Also as a side benefit, three samples per station provides a basis for various statistical analyses, if random samples are all taken from a rubble substrate in as similar habitat as possible, taking into account mainly the velocity of flow and depth in the stream. Biologists have found that compared to other sampling devices, the Winget-modified surber net yields the highest coefficient of correlation (similarity of samples).

A stream's natural potential for productivity, habitat quality and water quality can be compared to the "actual" by taking quantitative samples of aquatic macroinvertebrates. Careful analysis of macroinvertebrate communities can reveal condition and trends in aquatic ecosystems. Sampling and analysis is conducted in accordance with procedures outlined in FSH R-4 2609.23, March 1985, Fisheries Habitat Surveys Handbook.

This report is based upon 27 macroinvertebrate samples from 6 stations on North Fork American Fork River and 3 stations on Mary Ellen Gulch Creek along with physical and water chemistry data provided by your aquatic specialist. Samples were taken above and below old mine sites to determine possible effects of mine drainage upon the streams water quality and aquatic life. Zinc concentrations on the North Fork American Fork River ranged from less than 0.02 mg/l at Stations 1, 3A and 8 to 0.190 mg/l at Station 3 below the lower bog mine. Zinc concentrations on Mary Ellen Gulch Creek ranged from 0.022 mg/l at Station 12 above the mine drainage to 0.092 mg/l at Station 14 below the mine effluents.

NORTH FORK AMERICAN FORK RIVER

The Upper Station (1) was above the lower bog mine. Macroinvertebrate samples were also taken at Station 3 just below the lower bog mine to evaluate the effects of mine drainage from the old mine site. Of the heavy metals tested, zinc appeared to be the most potentially damaging heavy metal in the effluents from the mines along the North Fork. At Station 1 above the lower bog mine the zinc concentration was less than 0.02 mg/l, which was a non-limiting concentration. The aquatic macroinvertebrate community had fairly good diversity among clean water taxa at this station which included clean water mayflies *Rhyacozana* and *Ephemeraella daddsi*, with fair population numbers. The clean water stoneflies *Zanada* and members of the family Leuctridae were present in good resident population numbers. These species indicated relatively good substrate and good water quality at the upper Station (1). The zinc concentration was slightly higher when sampled in July at this station.

At Station 3 below the lower bog mine the zinc concentration was 0.190 mg/l, which was higher than found in July when it was 0.077 mg/l. The zinc concentration in September exceeded the threshold value of 0.1 mg/l for sensitive aquatic invertebrates. A comparison of the communities at the upper Station (1) and the station below the bog mine (3) indicates that there were stress conditions at the lower reach. The number of organisms/m² was reduced 78%, from nearly 9,000 to less than 2,000. The macroinvertebrate standing crop was reduced by nearly 90%, from 0.9 to 0.1 g/m² and the BCI value was reduced from 93 to 79.

None of the taxa at Station 3 had good resident population numbers and many were limited to about 3/m². Those with the highest numbers were the most tolerant species in the community and apparently *Rhyacophila* which had been fairly comfortable with the zinc concentration in July was affected by the slightly higher concentration in September since it was no longer a dominant species in the community. The *Pisania*, which were doing so well in July were missing from the community in September. As found in July samples, the mayflies seem to be the most sensitive to the zinc and some of the shredder stoneflies appeared to be fairly resistant to the effects of this heavy metal.

In contrast, the macroinvertebrate community at Station 3A, located just above the Pacific mine area, had an excellent macroinvertebrate community with good diversity and high population numbers for the clean water species, which indicated good water quality and good instream substrate in that stream reach. There were warning numbers of those taxa tolerant to sedimentation, but good diversity and good resident population numbers for most of the taxa in the community indicated that there was good stability in this stream reach.

Also, the observed number of shredders in the community is generally found where riparian habitat is in good to excellent condition. The zinc concentration at this station was less than 0.02 mg/l. Clean water species present included mayflies *Ecnorus*, *Rhyacogena* and *Ephemerella doddsi*, stoneflies *Skwala* and *Zanada* and members of the family Leuctridae, and caddisflies *Parapsyche* and *Anatania*. These species were also found in the July samples at this station.

When sampled in September, the zinc concentration at Station 8 was less than 0.02 mg/l. This Station was located below the Pacific mine drainage area. The zinc concentration was much lower than the 0.081 mg/l found in July. However, this community was limited. Many of the species did not have resident population numbers and the number of organisms was reduced about 70%, to less than 4,000/m², compared to over 13,000/m² at Station 3A. The DAT diversity index value of 15.2 was much better than found in July at this station when it was 0.7. Conditions at this station appear to be somewhat better but were still limiting to the macroinvertebrate community in September.

At the Dutchman Flat Station (9) the zinc concentration was 0.037 mg/l, which was less than the 0.043 mg/l found in July. The DAT diversity index of 18 was much better than the 0.8 found in July, but the numbers of organisms in the community was just about the same and was close to that found at the Upper Station (1). Clean water species at this station had fairly good population numbers and included the mayflies *Ecnorus*, *Rhyacogena* and *Ephemerella doddsi*, stoneflies *Zanada* and members of the family Leuctridae, and caddisflies *Arctopsyche* and *Parapsyche*. There were indications of at least moderate amounts of sedimentation at this station. The observed number of shredders in the community is generally found where riparian habitat is in fairly good condition.

At the lowest station on the North Fork, the zinc concentration of 0.099 mg/l was higher than found in July when

it was 0.04 mg/l and was approaching the 0.1 mg/l threshold value for zinc. However, the macroinvertebrate community there included clean water species, which indicated good water quality and good instream substrate at this station. Clean water mayflies included *Ecnema*, *Rhyacogena* and *Ephemerella* *doddsi*, each found in July samples, and stoneflies *Zanada*, *Amphinemura* and members of the family Leuctridae, caddisflies *Arctonemura* and *Paranemura*, most with good population numbers. Good resident population numbers for most of the taxa in the community indicated good stability in this stream reach. The observed number of shredders in the community is generally found where riparian habitat is in good condition.

The potential for a resident fishery on this stream appeared to be good at Stations 3A and 11, where the macroinvertebrate biomass was sufficient to provide nutrients for a good fishery. It appeared that the water chemistry was limiting to biotic life at Stations 3 and 8 and could be limiting to the success of a fishery in those stream reaches. The most sensitive stages in the trout life cycle would probably be limited by the adverse water chemistry. The macroinvertebrate biomass of 0.1 g/m² at Station 3 and 0.4 and 0.6 g/m² at Stations 8 and 9 respectively, would be limiting to the success of a fishery.

The BCI values at most of the stations indicate there is good potential in this stream. The BCI value of 79 at Station 3 indicated just fair conditions there. There were impacts in that stream reach. It appears there may be some opportunity for management to improve the instream habitat quality and water quality in this aquatic ecosystem.

The effects of the mine drainage from the lower bog mine appeared to have more limiting effects in September than was observed in July and the effluents from the Pacific mine did not appear to be as limiting in September as they were in July. It appeared that even though there were indications of adverse effects from the mine effluents in the reaches of stream sampled, particularly below the mine sites, the effects on the biotic community were not severe but were limiting. Some of the zinc concentrations were fairly close to threshold levels for sensitive aquatic species. The zinc concentrations were rather quickly diluted as they entered the main stream from the mine sites and as the water flowed down stream further accretion flows appeared to decrease the effects of the adverse water chemistry.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator Paul Skabelund
Forest/District Uinta N.F.
Stream NORTH FORK AMERICAN FORK RIVER
State/County Utah, Utah County
Forest Service Cat. No. _____

Organisms /m ²	B.		Diversity Index DAT (mean)	Standing Crop g/m ² (mean)	Biotic Condition Index BCI 50	#Taxa
	Station	Date(s)				
981	1 (Abv bog M)	9-21-88	10.2	0.9	93	21
922	3 (Bel bog M)	9-21-88	11.5	0.1	79	21
13,091	3A (Abv Pac M)	9-22-88	19.2	1.4	100	32
3,888	8 (Bel Pac M)	9-22-88	15.2	0.4	100	31
7,819	9 (Dutch Fl)	9-22-88	18.2	0.6	98	32
9,555	11 (Bel MEG)	9-22-88	16.4	2.1	100	25
7,866	1	7-20-88	1.0	1.0	100	20
5,193	3	7-20-88	0.6	0.6	82	25
13,891	3A	7-20-88	1.8	1.8	91	25
2,582	8	7-20-88	0.7	0.7	98	25
8,730	9	7-20-88	0.8	0.8	88	23
18,163	11	7-20-88	1.3	1.3	85	22

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1

NORTH FORK AMERICAN FORK RIVER (ABV BOG MINE), UINTA NF

DATE: 09 21 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
• NUMBERS DATA											
3	21	8981.	4947.	13015.	3704.52	23.81	41.25	2.6345	0.4006	53.	54.

SPECIES TOLERANCE CODES

- = Clean water species
- | = Moderately tolerant species
- = Shredders - Depend upon deciduous vegetation from riparian areas)
- S = Sediment tolerant
- O = Organic enrichment tolerant
- Ch = Resistant to adverse chemistry
- C = Large stonefly species

SPECIES ANALYSES

STATION: 1

NORTH FORK AMERICAN FORK RIVER (ABV BOG MINE), UINTA NF

DATE: 09 21 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPEHEMROPTERA	HEPTAGENIIDAE	CINYGMULA		997.09	2.999	30.	90.	
INSECTA	EPEHEMROPTERA	HEPTAGENIIDAE	RHITHROGENA		107.60	2.032	21.	43.	
INSECTA	EPEHEMROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INNERMIS	35.87	1.555	48.	75.	
INSECTA	EPEHEMROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	43.04	1.634	2.	3.	
INSECTA	EPEHEMROPTERA	SIPHONURIDAE	AMELETUS		7.17	0.856	48.	41.	
INSECTA	EPEHEMROPTERA	BAETIDAE	BAETIS		4598.11	3.663	72.	284.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			43.04	1.634	24.	39.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		14.35	1.157	48.	56.	
INSECTA	PLECOPTERA	CAPNIIDAE			638.43	2.805	32.	90.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		487.79	2.688	16.	43.	
INSECTA	PLECOPTERA	LEUCTRIDAE			405.88	2.612	18.	47.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	ACROPEDES	279.78	2.447	18.	44.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		7.17	0.856	24.	21.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		14.35	1.157	38.	42.	
INSECTA	DIPTERA	CHIRONOMIDAE			538.00	2.731	108.	295.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		14.35	1.157	38.	42.	
CRUSTACEA	OSIRACODA				315.63	2.499	108.	270.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		286.93	2.458	108.	265.	
OLIGOCHAETA					78.91	1.897	108.	205.	
ARACHNIDA	HYDRACARINA				57.39	1.759	98.	172.	
NEMATODA					7.17	0.856	108.	92.	
TOTALS					8981.01	3.953			0.40

TOTAL SAMPLE STATISTICS

STATION: 3

NORTH FORK AMERICAN FORK RIVER (BEL LOWER BOG MINE), UINTA NF

DATE: 09 21 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
• NUMBERS DATA											
3	21	1922.	923.	2922.	917.59	27.58	47.73	2.8333	0.3588	61.	63.

SPECIES ANALYSES

STATION: 3

NORTH FORK AMERICAN FORK RIVER (BEL LOWER BOG MINE), UINTA NF

DATE: 09 21 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS	INERMIS	3.59	0.555	21.	12.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		7.17	0.856	21.	18.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA		107.00	2.032	48.	98.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		21.52	1.333	72.	96.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			32.28	1.509	24.	36.	
INSECTA	PLECOPTERA	CAPNIIDAE			161.40	2.208	32.	71.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		32.28	1.509	16.	24.	
INSECTA	PLECOPTERA	LEUCTRIDAE			347.91	2.541	18.	46.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		46.03	1.669	18.	30.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		3.59	0.555	24.	13.	
INSECTA	COLEOPTERA				3.59	0.555	108.	60.	
INSECTA	DIPTERA	MELYRIDAE			3.59	0.555	108.	60.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		3.59	0.555	24.	13.	
INSECTA	DIPTERA	HIRONOMIDAE			763.98	2.883	108.	311.	
INSECTA	DIPTERA	EMPIDIDAE			50.21	1.701	95.	162.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		3.59	0.555	36.	20.	
INSECTA	DIPTERA	EMPIDIDAE	HEMERODROMIA		3.59	0.555	95.	53.	
CRUSTACEA	COPEPODA				3.59	0.555	108.	60.	
CRUSTACEA	OSTRACODA				222.37	2.347	108.	253.	
OLIGOCHAETA					78.91	1.897	108.	205.	
ARACHNIDA	HYDRACARINA				21.52	1.333	98.	131.	
TOTALS					1922.45	3.284			0.10

TOTAL SAMPLE STATISTICS

STATION: 3A

NORTH FORK AMERICAN FORK RIVER (ABV PACIFIC MINE), UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
• NUMBERS DATA											
3	32	13091.	8605.	17578.	4120.41	18.17	31.47	4.0198	0.1962	46.	46.

SPECIES ANALYSES

STATION: 3A

NORTH FORK AMERICAN FORK RIVER (ABV PACIFIC MINE), UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		114.77	2.060	21.	43.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		1291.20	3.111	30.	93.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		1040.13	3.017	21.	63.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	COLORADENSIS	14.35	1.157	18.	21.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	1707.25	3.232	48.	155.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	1032.96	3.014	2.	6.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		1721.60	3.236	72.	233.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			301.28	2.479	24.	59.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA	PARALLELA	28.69	1.458	18.	26.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		43.04	1.634	24.	39.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		315.83	2.499	48.	120.	
INSECTA	PLECOPTERA	CAPNIIDAE			631.25	2.800	32.	90.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		329.97	2.518	16.	40.	
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		129.12	2.111	36.	76.	
INSECTA	PLECOPTERA	LEUCTRIDAE			272.59	2.436	18.	44.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		344.32	2.537	108.	274.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE		559.52	2.748	6.	16.	
INSECTA	TRICHOPTERA	LIMNIPHILIDAE	OLIGOPHLEBODES		14.35	1.157	24.	28.	
INSECTA	TRICHOPTERA	LIMNIPHILIDAE	APATANIA		28.69	1.458	18.	26.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		157.81	2.198	18.	40.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		172.16	2.236	24.	54.	
INSECTA	TRICHOPTERA	LEPIDOSTOMATIDAE			43.04	1.634	18.	29.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		86.08	1.935	24.	46.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		14.35	1.157	36.	42.	
INSECTA	DIPTERA	SIMULIIDAE			28.69	1.458	108.	157.	
INSECTA	DIPTERA	CHIRONOMIDAE			1092.91	3.229	108.	349.	
INSECTA	DIPTERA	EMPIIDAE			71.73	1.856	95.	176.	
INSECTA	DIPTERA	CERATOPOGONIDAE			28.69	1.458	108.	157.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		200.85	2.303	36.	83.	
CRUSTACEA	OSTRACODA				329.97	2.518	108.	272.	
OLIGOCHAETA					28.69	1.458	108.	157.	
ARACHNIDA	HYDRACARINA				315.63	2.499	98.	245.	
TOTALS					13091.34	4.117			1.40

TOTAL SAMPLE STATISTICS

STATION: 8

NORTH FORK AMERICAN FORK RIVER (BEL PACIFIC MINE), UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
• NUMBERS DATA											
3	31	3888.	2627.	5148.	1167.68	17.19	29.77	3.4025	0.3144	52.	50.

SPECIES ANALYSES

STATION: 8

NORTH FORK AMERICAN FORK RIVER (BEL PACIFIC MINE), UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		39.45	1.596	21.	34.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		39.45	1.596	30.	40.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		114.77	2.060	21.	43.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	COLORADENSIS	7.17	0.856	18.	15.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	86.08	1.935	48.	93.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	75.32	1.877	2.	4.	
INSECTA	EPHEMEROPTERA	BAETIIDAE	BAETIS		1477.71	3.170	72.	228.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			25.11	1.400	24.	34.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		17.93	1.254	24.	30.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		89.67	1.953	48.	94.	
INSECTA	PLECOPTERA	CAPNIIDAE			68.15	1.833	32.	59.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		129.12	2.111	16.	34.	
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		10.76	1.032	36.	37.	
INSECTA	PLECOPTERA	LEUCTRIDAE			17.93	1.254	18.	23.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		32.28	1.509	108.	163.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		161.40	2.208	18.	40.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE		64.58	1.810	6.	11.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		132.71	2.123	18.	38.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		261.83	2.418	24.	58.	
INSECTA	COLEOPTERA	ELMIDAE			10.76	1.032	104.	107.	
INSECTA	DIPTERA				10.76	1.032	108.	111.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		7.17	0.856	24.	21.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		7.17	0.856	36.	31.	
INSECTA	DIPTERA	CHIRONOMIDAE			347.91	2.541	108.	274.	
INSECTA	DIPTERA	EMPIDIDAE			469.85	2.672	95.	254.	
INSECTA	DIPTERA	CERATOPOGONIDAE			3.59	0.555	108.	60.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		17.93	1.254	36.	45.	
CRUSTACEA	OSTRACODA				10.76	1.032	108.	111.	
OLIGOCHAETA					10.76	1.032	108.	111.	
ARACHNIDA	HYDRACARINA				136.29	2.134	98.	209.	
NEMATODA					3.59	0.555	108.	60.	
TOTALS					3887.95	3.590			0.40

14

TOTAL SAMPLE STATISTICS

STATION: 9

NORTH FORK AMERICAN FORK RIVER (DUTCHMAN FLAT), UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
• NUMBERS DATA											
3	32	7819.	4711.	10926.	2853.86	21.07	36.50	3.5363	0.2929	50.	51.

SPECIES ANALYSES

STATION: 9

NORTH FORK AMERICAN FORK RIVER (DUTCHMAN FLAT), UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		114.77	2.060	21.	43.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		161.40	2.208	30.	66.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		667.12	2.824	21.	59.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	86.08	1.935	48.	93.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	186.51	2.271	2.	5.	
INSECTA	EPHEMEROPTERA	SIPHONURIDAE	AMELETUS		28.69	1.458	48.	70.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		2403.07	3.381	72.	243.	
INSECTA	PLECOPTERA				14.35	1.157	48.	56.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			269.00	2.430	24.	50.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		21.52	1.333	24.	32.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		984.81	2.984	48.	143.	
INSECTA	PLECOPTERA	CAPNIIDAE			418.05	2.619	32.	84.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		254.65	2.406	18.	38.	
INSECTA	PLECOPTERA	LEUCTRIDAE			53.80	1.731	18.	31.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOGENOIDES		17.93	1.254	24.	30.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		39.45	1.596	108.	172.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		57.39	1.759	18.	32.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE		39.45	1.596	6.	10.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		28.69	1.458	18.	26.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		60.97	1.785	24.	43.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	ACROPEDES	14.35	1.157	18.	21.	
INSECTA	COLEOPTERA	ELMIDAE			57.39	1.759	104.	183.	
INSECTA	DIPTERA				154.23	2.188	108.	236.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		86.08	1.935	24.	46.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		10.76	1.032	36.	37.	
INSECTA	DIPTERA	SIMULIIDAE			93.25	1.970	108.	213.	
INSECTA	DIPTERA	CHIRONOMIDAE			1169.25	3.068	108.	331.	
INSECTA	DIPTERA	EMPIDIDAE			50.21	1.701	95.	162.	
INSECTA	DIPTERA	CERATOPOGONIDAE			10.76	1.032	108.	111.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		17.93	1.254	36.	45.	
CRUSTACEA	OSTRACODA				68.15	1.833	108.	198.	
ARACHNIDA	HYDRACARINA				200.85	2.303	98.	226.	
TOTALS					7818.93	3.893			0.60

MARY ELLEN GULCH CREEK

At the Upper Station (12) above the mine, clean water species included mayflies *Rhyacogena* and *Ephemerella daddsi* with fairly good population numbers, and the stonefly *Zanada* with excellent population numbers, which indicated good water quality and some good instream substrate in that stream reach. The observed number of shredders in the community is generally found where riparian habitat is in good condition. The zinc concentration there was just 0.022 mg/l, which was below the threshold value. Good diversity and resident population numbers for many of the taxa in the community at Station 12 indicated good stability in that stream reach.

Of the stations sampled, Station 14 below Mary Ellen Gulch Creek Mine showed the most severe impacts. All of the analysis elements indicated that there were severe impacts at this station. At the control station above the mine effluents the DAT was 11.7; at Station 14 below the mine effluents it was 1.9. The standing crop had decreased 83% from 2.3 to 0.4 g/m², the BCI value from 89 to 78, and the number of taxa from 20 to 15. The only species with a resident population number at Station 14 was the adverse water chemistry and sediment tolerant *Chironomids*, which numbered far less than was found in July. Most of the other taxa in the community had extremely limited numbers in their populations and were not living successfully in the reach sampled. The zinc concentration of 0.092 mg/l was close to the threshold value for sensitive aquatic species. There were 6,500 organisms/m², but 5,200 were *Chironomids*.

At the mouth of Mary Ellen Creek (Station 10) near its confluence with North Fork of the American Fork River the macroinvertebrate community showed that the ecosystem had recovered considerably by the time it reached that point. Clean water species present at that station included mayflies *Ecnorus*, *Rhyacogena* and *Ephemerella daddsi*, stoneflies *Zanada* and members of the family Leuctridae, and caddisflies *Axestansyche* and *Eaxansyche*, which indicated relatively good water quality in that stream reach and that the toxic effects of the zinc and other possible heavy metals that may synergistically have been operating at Station 14, no longer had a serious detrimental effect in the aquatic ecosystem. The zinc concentration at Station 10 was 0.041 mg/l which was below the threshold value and was lower than found in July. The same clean water species were present at station 10 as were found at

the Control Station (12) above the mine. These clean water taxa were not present at the station directly below the mine.

The potential for a resident fishery on this stream appeared to be fairly good in the reaches of stream sampled above the mine and at the mouth. However, it appeared the fishery would be extremely limited at Station 14 below the mine. Scarcity of clean water taxa in the community and abundance of sediment tolerant taxa, particularly the *Chironomids*, indicated there would be a very limited amount of suitable spawning substrate. Also, the water chemistry would probably not be compatible with the most sensitive life stages in the life cycle of a trout. The macroinvertebrate biomass at Stations 10 and 12 would be sufficient to provide nutrients for a fishery, but 0.4 g/m^2 at Station 14 would be limiting to a fishery.

A BCI value of 100 at Station 10 indicated that this reach of stream was close to its potential; the BCI value of 89 at Station 12 indicated good conditions at the upper station, and a BCI of 78 at Station 14 indicated just fair conditions in that stream reach and that was based on a community where most species did not have resident population numbers.

September samples were expected to show more severe effects from the mine drainages on these streams than were observed in July. This was true at Stations 3 and 14, however, in general it appeared that distant, down-stream effects were less than those found in July. It appears that the sediment and heavy metals, particularly the zinc, entering these aquatic ecosystems is detrimental to the aquatic life in the vicinity of the effluents from the old mines. As accretion flows dilute the heavy metals down-stream reaches appear to become more and more capable of supporting aquatic life. It appears there would be opportunities for management to improve the instream habitat quality and water quality below each of the mine sites monitored in 1988 along the North Fork American Fork River and Mary Ellen Creek ecosystems.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Aquatic Ecosystem Analysis Laboratory
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Provo, Utah 84602

A. Investigator Paul Skabelund
Forest/District Uinta N.F.
Stream MARY ELLEN CREEK
State/County Utah, Utah County
Forest Service Cat. No. _____

Organisms /m ²	B.		Diversity Index DAT (mean)	Standing Crop g/m ² (mean)	Biotic Condition Index BCI 50	#Taxa
	Station	Date(s)				
8,013	10 (Mouth)	9-22-88	15.2	1.4	100	25
6,685	12 (Ab M)	9-22-88	11.7	2.3	89	20
6,528	14 (Bel M)	9-22-88	1.9	0.4	78	15
13,884	10	7-20-88	7.8	2.1	88	22
12,424	12	7-21-88	11.6	2.1	79	17
30,110	14	7-21-88	1.2	2.0	100	22

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 11

AMERICAN FORK RIVER, UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
* NUMBERS DATA											
3	25	9555.	7238.	11871.	2127.33	12.85	22.26	3.7368	0.1959	49.	47.

SPECIES ANALYSES

STATION: 11

AMERICAN FORK RIVER, UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS	DODDSI	243.89	2.387	21.	50.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYMULA		286.93	2.458	30.	74.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		1004.27	3.002	21.	63.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA		157.81	2.198	2.	4.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		2395.89	3.379	72.	243.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			387.36	2.588	24.	62.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		14.35	1.157	24.	28.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		789.87	2.897	48.	139.	
INSECTA	PLECOPTERA	CAPNIIDAE			731.68	2.864	32.	92.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		688.64	2.838	16.	45.	
INSECTA	PLECOPTERA	NEMOURIDAE	AMPHINEMURA	ch, 1110 STOT11111 TANPHON	157.81	2.198	6.	13.	
INSECTA	PLECOPTERA	LEUCTRIDAE			14.35	1.157	18.	21.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		88.08	1.935	18.	35.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE		487.79	2.688	6.	18.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		301.28	2.479	18.	45.	
INSECTA	DIPTERA				57.39	1.759	108.	198.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		57.39	1.759	24.	42.	
INSECTA	DIPTERA	SIMULIIDAE			832.11	2.920	108.	315.	
INSECTA	DIPTERA	CHIRONOMIDAE			387.36	2.588	108.	288.	
INSECTA	DIPTERA	EMPIDIDAE			172.16	2.236	95.	212.	
INSECTA	DIPTERA	BLEPHARICERIDAE			129.12	2.111	2.	4.	
CRUSTACEA	OSTRACODA				28.69	1.458	108.	157.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		28.69	1.458	108.	157.	
ARACHNIDA	HYDRACARINA				100.43	2.002	98.	196.	
NEMATODA					14.35	1.157	108.	125.	
TOTALS					9554.88	3.980			2.10

TOTAL SAMPLE STATISTICS

STATION: 10

MARY ELLEN CREEK (MOUTH), UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
• NUMBERS DATA											
3	25	8013.	4399.	11626.	3318.29	23.91	41.41	3.6554	0.2135	45.	43.

SPECIES ANALYSES

STATION: 10

MARY ELLEN CREEK (MOUTH), UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS	INERMIS DODDSI	168.57	2.227	21.	47.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		1104.69	3.043	30.	91.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		642.01	2.808	21.	59.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA		89.67	1.953	48.	94.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA		243.89	2.387	2.	5.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		1979.84	3.297	72.	237.	
INSECTA	PLECOPTERA				43.04	1.634	48.	78.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			885.91	2.947	24.	71.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		25.11	1.400	24.	34.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		204.44	2.311	48.	111.	
INSECTA	PLECOPTERA	CAPNIIDAE		ROSSI	813.32	2.708	32.	89.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		545.17	2.737	16.	44.	
INSECTA	PLECOPTERA	LEUCTRIDAE			344.32	2.537	18.	46.	
INSECTA	TRICHOPTERA				14.35	1.157	72.	83.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		157.81	2.198	18.	40.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE		154.23	2.188	6.	13.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		143.47	2.157	18.	39.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		10.78	1.032	24.	25.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		68.15	1.833	24.	44.	
INSECTA	DIPTERA	CHIRONOMIDAE			218.79	2.340	108.	253.	
INSECTA	DIPTERA	EMPIIDAE		ROSSI	60.97	1.785	95.	170.	
INSECTA	DIPTERA	PELECORHYNCHIDAE	GLUTOPS		14.35	1.157	30.	35.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		200.85	2.303	108.	249.	
ARACHNIDA	HYDRACARINA				53.80	1.731	98.	170.	
NEMATODA					25.11	1.400	108.	151.	
TOTALS					8012.61	3.904			1.40

TOTAL SAMPLE STATISTICS

STATION: 12

MARY ELLEN CREEK, UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (90 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
* NUMBERS DATA											
3	20	26685.	13503.	39866.	12105.49	26.19	45.36	3.0992	0.2833	57.	56.

SPECIES ANALYSES

STATION: 12

MARY ELLEN CREEK, UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA	INERMIS DODDSI	5910.83	3.772	30.	113.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		114.77	2.060	21.	43.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA		2266.77	3.355	48.	161.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA		88.08	1.935	2.	4.	
INSECTA	EPHEMEROPTERA	SIPHONURIDAE	AMELETUS		315.63	2.499	48.	120.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		946.88	2.976	72.	214.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			88.08	1.935	24.	46.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		200.85	2.303	24.	55.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		28.69	1.458	48.	70.	
INSECTA	PLECOPTERA	CAPNIIDAE			1291.20	3.111	32.	100.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA	2410.24	3.382	16.	54.		
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE	315.63	2.499	108.	270.		
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	1778.99	3.250	18.	59.		
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA	172.16	2.236	24.	54.		
INSECTA	DIPTERA	CHIRONOMIDAE		5652.59	3.752	108.	405.		
INSECTA	DIPTERA	EMPIDIDAE		28.69	1.458	95.	138.		
CRUSTACEA	COPEPODA			28.69	1.458	108.	157.		
CRUSTACEA	OSTRACODA			4791.79	3.680	108.	397.		
OLIGOCHAETA				28.69	1.458	108.	157.		
ARACHNIDA	HYDRACARINA			229.55	2.361	98.	231.		
TOTALS					26684.80	4.426			2.30

TOTAL SAMPLE STATISTICS

STATION: 14

MARY ELLEN CREEK, UINTA NF

DATE: 09 22 88

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT)		STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
			LL	UL							
* NUMBERS DATA											
3	15	6528.	4888.	8176.	1513.35	13.38	23.18	1.3199	0.6639	62.	64.

SPECIES ANALYSES

STATION: 14

MARY ELLEN CREEK, UINTA NF

DATE: 09 22 88

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS	11	14.35	1.157	21.	24.	
INSECTA	EPHEMEROPTERA	SIPHONURIDAE	AMELETUS	5,0	14.35	1.157	48.	58.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		143.47	2.157	72.	155.	
INSECTA	PLECOPTERA				14.35	1.157	48.	58.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			100.43	2.002	24.	48.	
INSECTA	PLECOPTERA	CAPNIIDAE		11	57.39	1.759	32.	58.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		100.43	2.002	16.	32.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	ACROPEDES	401.71	2.604	18.	47.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA	1, ch	57.39	1.759	24.	42.	
INSECTA	DIPTERA	SIMULIIDAE			28.69	1.458	108.	157.	
INSECTA	DIPTERA	CHIRONOMIDAE		ch, 5,0	5236.53	3.719	108.	402.	
INSECTA	DIPTERA	EMPIDIDAE			14.35	1.157	95.	110.	
INSECTA	DIPTERA	CERATOPOGONIDAE		5, 3 ch	258.24	2.412	108.	260.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA	5,0	28.69	1.458	108.	157.	
ARACHNIDA	HYDRACARINA				57.39	1.759	98.	172.	
TOTALS					6527.73	3.815			0.40

Paul Skidmore
Hinterland U.S.

PRELIMINARY SURVEY OF WATER QUALITY
IN MINE DRAINAGE IN SHEEPROCK MOUNTAINS AND
NORTH FORK OF THE AMERICAN FORK RIVER

FOR

UINTA NATIONAL FOREST

BY

AVERE B. MERRITT, Ph.D., P.E.
Environmental Engineer

Provo, Utah
July 1988

1/19/89

Pete:

I agree to me that we should
have to concern about lead & zinc,
and in some instances cadmium
and arsenic.

Gene W. Hume

Introduction

As part of an abandoned/inactive mine survey, several mines in the Sheeprock Mountains and in the American Fork River drainage were visited and water samples taken from mine drainage waters and nearby natural drainage streams on May 12 and May 18, 1988 respectively.

This survey was intended to help identify the locations and water quality parameters that would need more intensive sampling and evaluation later.

Quality Comparison Basis

Although heavy metal standards for quality for a cold water sports fishery would need to be somewhat more stringent than for drinking water, in this survey phase drinking water standards are used for comparison. Macroinvertebrate samples will then be used in selected areas to indicate the nature of the ecosystem stresses and then heavy metal conclusions drawn from those and additional water sampling results.

EPA Regulations

§ 141.11 Maximum contaminant levels for inorganic chemicals.

(a) The maximum contaminant level for nitrate is applicable to both community water systems and non-community water systems. The levels for the other inorganic chemicals apply only to community water systems. Compliance with maximum contaminant levels for inorganic chemicals is calculated pursuant to § 141.23.

(b) The following are the maximum contaminant levels for inorganic chemicals other than fluoride:

Contaminant	Level, milligrams per liter
Arsenic	0.05
Barium	1
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05

(c) When the annual average of the maximum daily air temperatures for the location in which the community water system is situated is the following, the maximum contaminant levels for fluoride are:

Temperature Degrees Fahrenheit	Temperature Degrees Celsius	Level, milligrams per liter
32.7 and below	17.0 and below	2.4
32.7 to 44.2	12.1 to 14.6	2.2
44.2 to 54.7	14.7 to 17.8	2.0
54.7 to 70.6	17.7 to 21.4	1.8
70.7 to 79.2	21.5 to 26.2	1.6
79.3 to 90.3	26.3 to 32.3	1.4

§ 141.12 Maximum contaminant levels for organic chemicals.

The following are the maximum contaminant levels for organic chemicals. They apply only to community water systems. Compliance with maximum contaminant levels for organic chemicals is calculated pursuant to § 141.24.

	Level, milligrams per liter
(a) Chlorinated hydrocarbons:	
Endrin (1,2,3,4,10, 10-hexachloro-8,7-epoxy-1,4, 4a,5,6,7,8,8a-octa-hydro-1,4-endo, endo-5,8 - di-methano naphthalene).	0.0002
Lindane (1,2,3,4,5,6-hexachloro-cyclohexane, gamma isomer).	0.004
Methoxychlor (1,1,1-Trichloro-2, 2 - bis [p-methoxyphenyl] ethane).	0.1
Toxaphene (C ₁₂ H ₈ Cl ₂ -Technical chlorinated camphene, 67-69 percent chlorine).	0.005

Secondary Maximum Contaminant Levels for public water systems are:

Contaminant	SMCL
Chloride	250 mg/L
Color	15 color units
Copper	1 mg/L
Corrosivity	Noncorrosive
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3(TON)
pH	6.5-8.5
Sulfate	250 mg/L
Total dissolved solids	500 mg/L
Zinc	5 mg/L

These levels represent reasonable goals for drinking water quality. The states may establish higher or lower levels which may be appropriate dependent upon local conditions such as unavailability of alternate source waters or other compelling factors, provided that public health and welfare are not adversely affected.

I. Sheeprock Mountains

A. HARKER MINE in the Harker Creek Drainage of the Sheeprock Mountains near Vernon, Utah.

East Portal (probably evaporatory shaft) was flowing about 0.1 cfs of clear water. The test results indicate the water to be of good quality with no heavy metal concentrations of concern, with only As (Arsenic) (2.5 ug/l) and Ba (Barium) (27 ug/l) above detection limits but both far below maximum allowed levels.

South Portal was flowing about 0.2 cfs of water, some signs of chemical instability in orangish precipitates and/or algae in pooled water at portal. Detectable levels of Cd (Cadmium), Pb (Lead), Ba (Barium), Fe (Iron), Mn (Manganese), and Zn (Zinc) were present. Lead at 585 ug/l and Zinc at 2700 ug/l are of some concern along with a pH of .

Conclusions These mine drainage waters are normally the main part if not the total flow of small Harker Creek this high in the drainage. During the late summer the stream is probably dry in spots down the stream below the mines. The aquatic habitat in these upper waters is naturally stressed (sediments, high temperatures, no flow) and not capable of supporting a balanced aquatic ecosystem including fish. When these mine drainage waters do flow into the lower reaches of the canyon drainage, mineral precipitation and dilution would make the relatively small amount of Pb and Zn of little concern.

Recommendation No action to be taken with the possible exception of piping the South Portal flow down past the spoils pile, a distance of perhaps 150 to 200 feet--a low-priority project in my opinion.

B. NORTH OAK BRUSH MINE in the North Oak Brush drainage of the Sheeprock Mountains near Vernon, Utah.

East Portal was the only portal observed to have portal drainage waters. The flow was approximately 0.1 cfs of clear water. As, Cd, Cu (Copper), Pb, Ba, Fe, Mn, and Zn were above detection limits but all rather low except Pb at 115 ug/l, Cd at 8 ug/l and Zn at 1200 ug/l which are still moderate.

The Creek was sampled about one-fourth mile below the mine. It was flowing about 0.3 cfs at this point. All detected metals in the mine drainage were at considerably lower levels at this point and none higher than drinking water standards.

Conclusions This mine drainage makes up a large part of the Creek flow this high in the drainage. The flow downstream is likely intermittent seasonally. The aquatic ecosystem is naturally stressed and not capable of supporting fish. The metals from the mine drainage are rather small quantities.

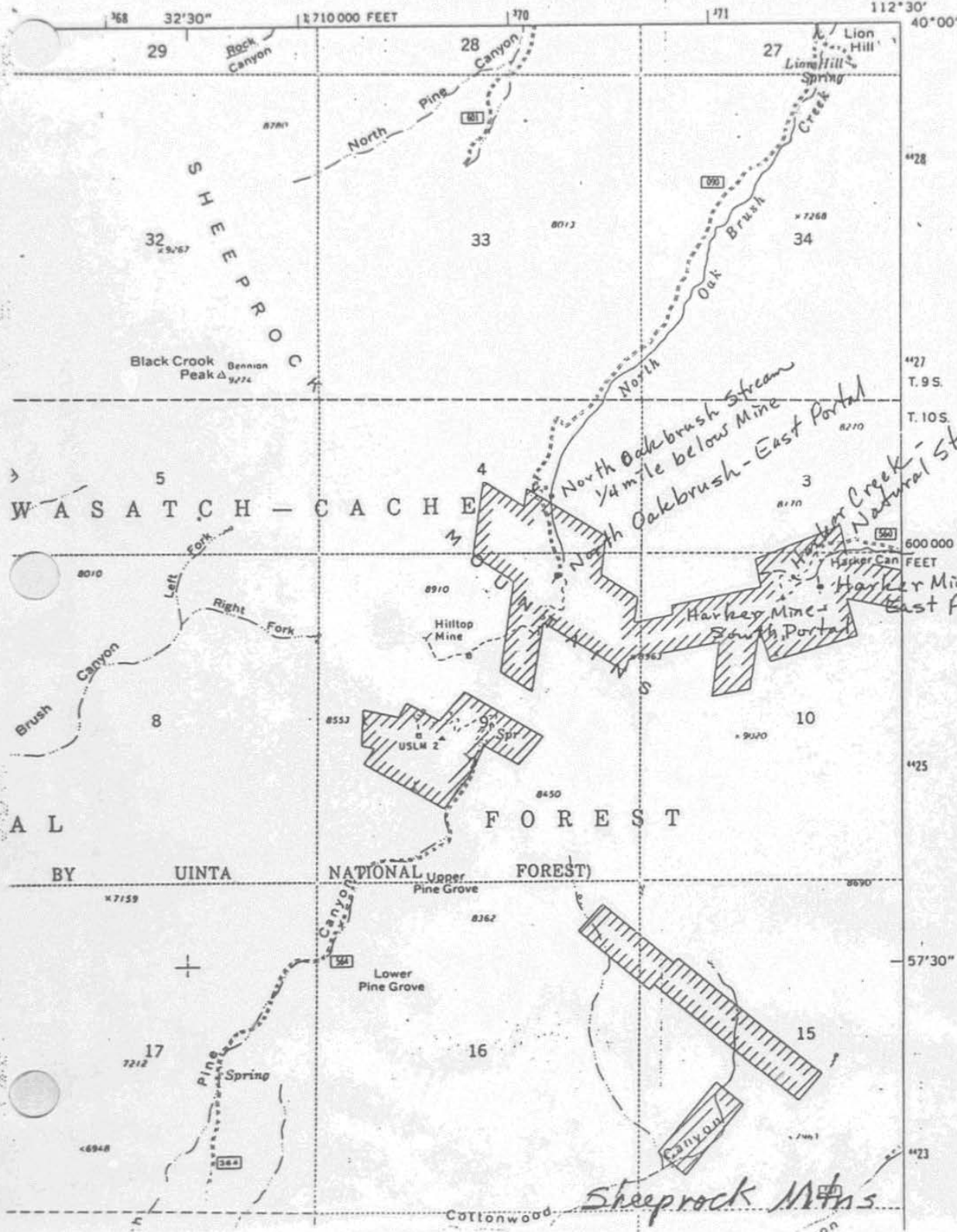
Recommendations - no action.

ERICKSON KNOLL QUADRANGLE

UTAH

7.5 MINUTE SERIES (TOPOGRAPHIC)

(VERNON)



II. North Fork of American Fork River above American Fork, Utah.

A. LOWER BOG MINE approximately 2 miles upstream of the Pacific Mine on east side of creek.

The portal drainage flow was about 0.1 cfs and the portal is covered by rubble. This is an Acid drainage of pH <4.5. Yellow precipitates are present. The flow percolates into the soil over some 200 feet and is not a surface flow into the creek (but is likely commingling with other percolating waters and seeping into the creek). Detectable levels of As, Cd, Ba, Fe, Mn and Zn are present but at fairly low levels with only Cd at 12 ug/l above DW standards.

Conclusions It was surprising that this acid drainage didn't contain higher levels of heavy metals. The fact that it percolates on into the stream undoubtedly mitigates its impact.

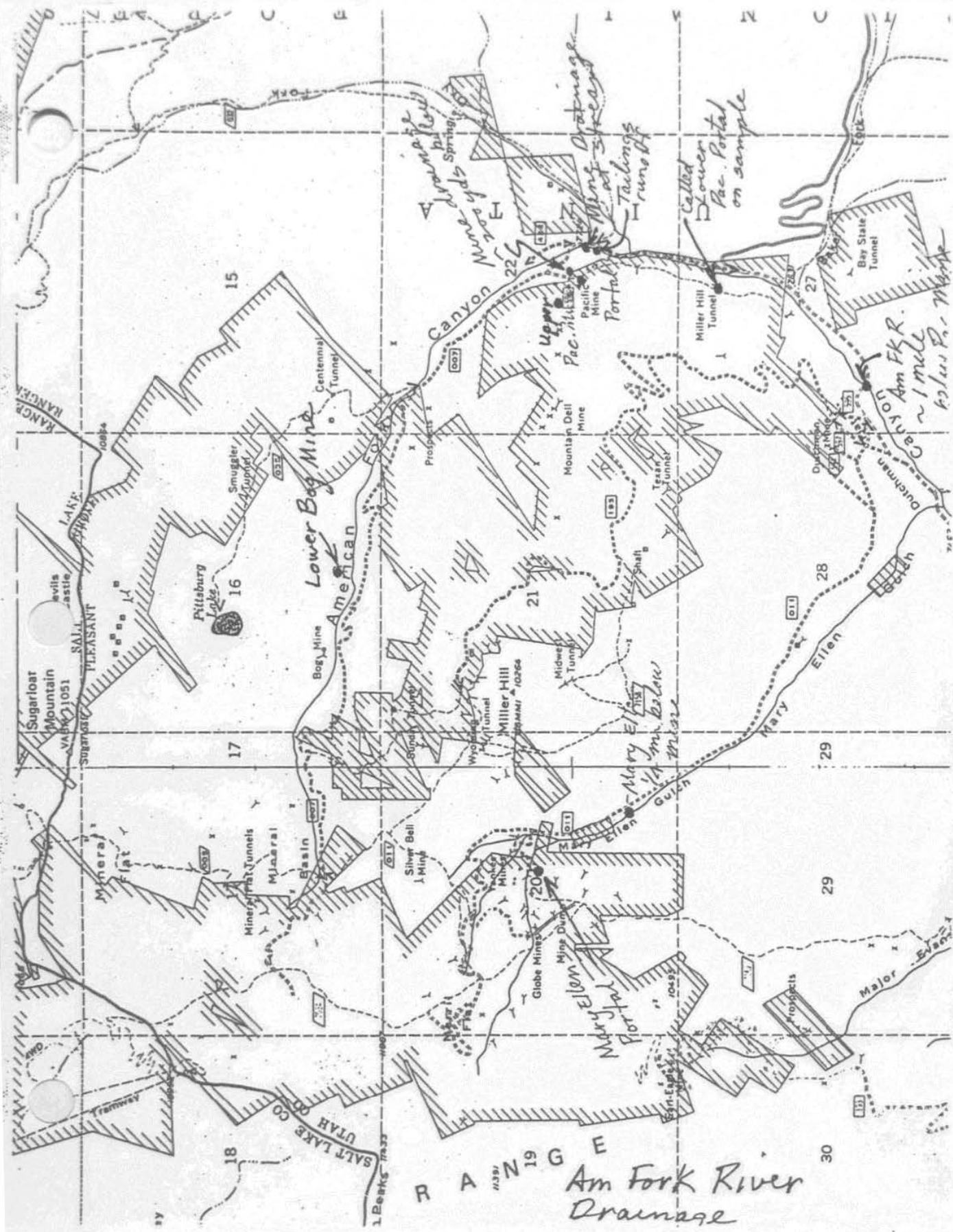
Recommendation - The relatively small percolating flow suggests no action on this mine drainage. However additional water quality samples and macroinvertebrate in the streamflow above and below the area during low stream in summer is desirable.

B. PACIFIC MINE

At Portal A drainage flow of about 0.2 cfs is not acidic. Detectable levels of most heavy metals were present but only As, Cu, and Pb are at significant levels at about one half of DW standards. As the flow continues on toward the stream, generally across spoil material, about 1/4 mile away it picks up metals and at the stream considerably higher levels are found with particular concern focusing on Pb at 4000 ug/l about 100 times DW standards of 50 ug/l. On the sampling day, a drizzling rain was causing a small runoff from the spoils/tailings; runoff flow of about 0.2 cfs was sampled at the bottom of the old spoils lagoon area near the stream. This sample gave by far the highest levels of heavy metals and As, Cd, & Pb were above DW standards with Pb by far the highest at 20,000 ug/l about 400 times the standard.

Upper Portal (NW Portal) A small mine drainage flow is piped from the portal and discharged a short distance downhill. The water is of high quality except Pb at 60 ug/l which is just above DW standards of 50 ug/l.

American Fork River A water sample from the stream (American Fork River) about 1 mile downstream contained some surface runoff and eroded sediment (light) on the day sampled. Quality was very good overall with only Pb at 60 ug/l of concern. This indicates that the upstream mine drainage was having some effect on the stream but the net result on the water quality was moderate to none. Since considerable amounts of heavy metals are likely precipitating in the stream, macroinvertebrate samples are needed to assess the impact.



R A N G E
Am Fork River
Drainage

Lower Bag Mine

American Bog Mine

Am Fork River
Drainage

Called Lower Portal on sample

Am Fork R. ~ 1 mile below P. Mine

Upper Pac. Mine

Tailings I run off

Miller Hill Tunnel

Bay State Tunnel

Mountain Dell Mine

Texas Tunnel

Duchman Tunnel

Midway Tunnel

Mary Ellen

Ellen

Miller Hill

Mary Ellen

Mary Ellen

Globe Mines

Mary Ellen

Mary Ellen

Miller Hill

Mary Ellen

Mary Ellen

Globe Mines

Mary Ellen

Mary Ellen

Globe Mines

Mary Ellen

Mary Ellen

Conclusions. The mine drainage waters are not a serious concern at the portals although they do carry slightly high levels of some heavy metals. The real problem is the spoils/tailings. These need to be treated/stabilized and drainage waters routed around the tailings. I am in full agreement with Ben Albrechtsen in his July 1985 file report.

Recommendations. Additional water quality samples should be taken in the stream above and below the site. This should be complemented by macroinvertebrate samples and habitat surveys.

(Miller Tunnel)

Lower Pacific Mine just across the stream from the junction in the road (Baker Junction) and about 1/2 mile downstream from Pacific Mine. The drainage water of about 0.1 cfs is of very good quality and shows essentially no heavy metals.

Recommendations. No action except that local runoff from the spoils piles go directly into the stream and the stream is undercutting the toe of the pile. This does not affect the mine drainage water.

C. MARY ELLEN MINE AREA

Mary Ellen Mine drainage flow of about 0.3 cfs at portal contained detectable levels of As, Cd, Cu, Pb, Ba, Fe, Mn and Zn, but only As at 100 ug/l was above the 50 ug/l DW standard. The flow had a pH of 6.5 which is slightly acidic. The "yellow boy" precipitates in the flow is in concert with the low pH. Some other surface waters in the area give indication of low pH--yellow precipitates. The sample on Mary Ellen Creek about 1/4 mile below the mine had detectable levels of most of the same metals but none exceeded DW standards although Pb was 4 times higher at 40 ug/l, likely indicating the impact of surface drainage leaching from the spoils areas upstream.

Conclusions. Given the rather large areas of spoils/tailings the effect on the stream water quality was less than expected although the rain ceased about 2 hours earlier and surface wash had diminished compared to the Pacific Mine area samples.

Recommendations. Additional water quality and macroinvertebrate samples should be taken during summer lower flow conditions.

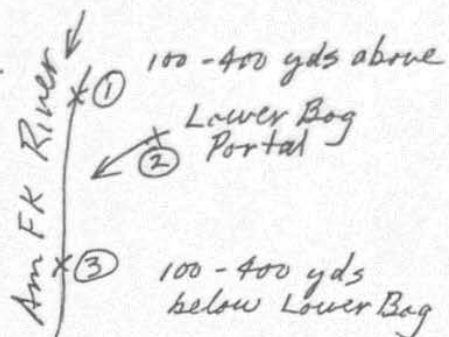
Recommended July 88 Sampling

Site	Water Quality															Other	macro invertebrate	
	TDS	Alk	pH	As	Cd	Cu	Pb	Hg	Ag	Ba	Cr	Fe	Mn	Se	Zn			
Lower Bog																		
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
Pacific																		
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
Mary Ellen																		
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓
5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Hard SO ₄	✓

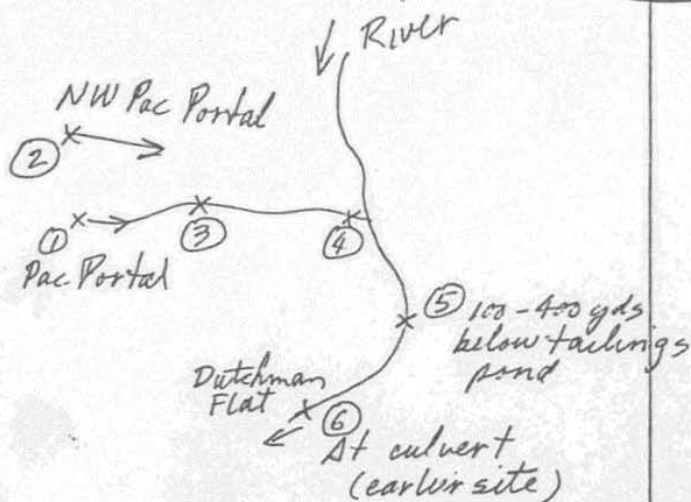
18 July 88 JBN

18 July 88 JBM

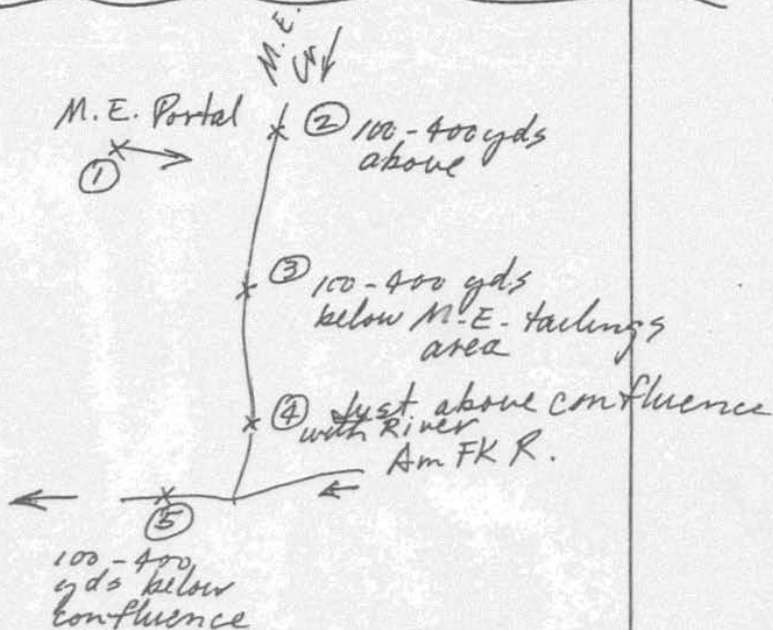
Schematic Site Map
Lower Bag



Pacific



Mary Ellen



APPENDIX

Water Sample Testing Results

88/06/09 12:02

Environmental Chemistry

JBO Pa

HARKER MINE EAST PORTAL
UINTA NAT. FOREST ATN. PAUL
P.O. BOX 829
PROVO UT

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: HARKER MINE EAST PORTAL

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802698 Type: 04

Sample Date: 88/05/12 Time: 10:10

Total Cations:

Total Anions: 50 me/l Cations:

Total: 50 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/06/09

Organic Review:

Radiochemistry Review:

1.7 Microbiology Review:

Laboratory Analyses

Total Alk.	84 mg/l
Total Arsenic	2.5 ug/l
Total Cadmium	<1 ug/l
Total Copper	<20.0 ug/l
Total Lead	<5.0 ug/l
Mercury	<0.2 ug/l
Total Silver	<2.0 ug/l

Total DS @ 180C	150 mg/l
Total Barium	0.027 mg/l
Total Chromium	<5.0 ug/l
Total Iron	<0.02 mg/l
Total Manganese	<5.0 ug/l
Total Selenium	<0.5 ug/l
Total Zinc	<20.0 ug/l

Description: HARKER MINE SOUTH PORTAL

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8802697 Type: 04

Sample Date: 88/05/12 Time: 10:30

Cations:

Anions: 17 me/l Cations:

rand total: 17 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/06/09

Organic Review:

Radiochemistry Review:

0.6 Microbiology Review:

Laboratory Analyses

Tot. Alk. 28 mg/l

T-Arsenic <1.0 ug/l

T-Cadmium <1.0 ug/l

T-Copper <20.0 ug/l

T-Lead 585.0 ug/l

Mercury <0.2 ug/l

T-Silver <2.0 ug/l

TDS @ 180C 100 mg/l

T-Barium 0.028 mg/l

T-Chromium <5.0 ug/l

T-Iron 0.76 mg/l

T-Manganese 420.0 ug/l

T-Selenium <0.5 ug/l

T-Zinc 2700.0 ug/l

88/06/09 12:02

JBO Page

HARKER NAT. CREEK PARALLEL TO SOUTH MINE
UTAH NAT. FOREST ATN. PAUL
P.O. BOX 829
PROVO UT 377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: HARKER NAT. CREEK PARALLEL TO SOUTH MINE
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802699 Type: 04 Date of Review and QA Validation
Sample Date: 88/05/12 Time: Inorganic Review: 88/06/09
Tot. Cations: Organic Review:
Tot. Anions: 28 me/l Cations: Radiochemistry Review:
and Total: 28 me/l Anions: 0.9 Microbiology Review:

Laboratory Analyses

Tot. Alk. 47 mg/l TDS @ 180C 82 mg/l

88/06/09 12:02

Environmental Chemistry

J80 Page:

NORTH OAK BRUSH EAST PORTAL
UINTA NAT. FOREST ATN. PAUL
P.O. BOX 829
PROVO

UT

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH OAK BRUSH EAST PORTAL
Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802696 Type: 04

Sample Date: 88/05/12 Time: 13:30

Tot. Cations:

Tot. Anions: 31 me/l Cations:

and Total: 31 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/06/09

Organic Review:

Radiochemistry Review:

1.0 Microbiology Review:

Laboratory Analyses

Tot. Alk.	52 mg/l
T-Arsenic	8.5 ug/l
T-Cadmium	1.8 ug/l
T-Copper	41.0 ug/l
T-Lead	115.0 ug/l
Mercury	<0.2 ug/l
T-Silver	<2.0 ug/l

TDS @ 180C	124 mg/l
T-Barium	0.011 mg/l
T-Chromium	<5.0 ug/l
T-Iron	5.5 mg/l
T-Manganese	83.0 ug/l
T-Selenium	<0.5 ug/l
T-Zinc	1200.0 ug/l

NORTH OAK BRUSH STREAM 1/4 MILE BL MINE
UTAH NAT. FOREST AIN. PAUL
P.O. BOX 829
PROVO UT 377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH OAK BRUSH STREAM 1/4 MILE BL MINE

Site ID: Source: 00

Cost Code: 350B

Lab Number: 8802695 Type: 04

Sample Date: 88/05/12 Time: 14:45

tot. Cations:

tot. Anions: 41 me/l Cations:

nd total: 41 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/06/09

Organic Review:

Radiochemistry Review:

1.4 Microbiology Review:

Laboratory Analyses

tot. Alk.	68 mg/l	TDS @ 180C	118 mg/l
I-Arsenic	<1.0 ug/l	I-Barium	0.017 mg/l
I-Cadmium	1 ug/l	I-Chromium	<5.0 ug/l
I-Copper	<20.0 ug/l	I-Iron	1.2 mg/l
I-Lead	40.0 ug/l	I-Manganese	160.0 ug/l
Mercury	<0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	80.0 ug/l

88/06/10 13:41

Environmental Chemistry

J80 Page

PORTAL LOWER BOG MINE
UNITA NATIONAL FOREST
88 W 100 N
PROVO

UT 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PORTAL LOWER BOG MINE
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802857 Type: 04
Sample Date: 88/05/18 Time: 12:30
Tot. Cations:
Tot. Anions: me/l Cations:
and Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

Tot. Alk.	0 mg/l	TDS @ 180C	90 mg/l
I-Arsenic	1.5 ug/l	I-Barium	0.037 mg/l
I-Cadmium	12 ug/l	I-Chromium	<5.0 ug/l
I-Copper	<20.0 ug/l	I-Iron	7.9 mg/l
I-Lead	<5.0 ug/l	I-Manganese	270.0 ug/l
Mercury	<0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	510.0 ug/l

88/06/10 13:41

Environmental Chemistry

J80 Page

PACIFIC MINE MAIN PORTAL AT ~~ADH~~ ^{OUTLET}
UTAH NATIONAL FOREST
88 W 100 N
PROVO UT 84603 377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE MAIN PORTAL AT ~~ADH~~ ^{OUTLET}

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802854 Type: 04

Sample Date: 88/05/18 Time: 10:00

Total Cations:

Anions: me/l Cations:

Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Total Alk.	163 mg/l	TDS @ 180C	202 mg/l
As-Arsenic	22.0 ug/l	Barium	0.069 mg/l
Cadmium	6.0 ug/l	Chromium	<5.0 ug/l
Copper	34.0 ug/l	Iron	4.0 mg/l
Lead	25.0 ug/l	Manganese	11.0 ug/l
Mercury	0.2 ug/l	Selenium	<0.5 ug/l
Silver	<2.0 ug/l	Zinc	800.0 ug/l

88/06/22 14:05

Environmental Chemistry

JRO Page:

PACIFIC MINE PORTAL FLOW 200 YDS. BELOW PORTA
UINTA NATIONAL FOREST

88 W 100 N

PROVO

UT 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC MINE PORTAL FLOW 200 YDS. BELOW PORTA

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802862 Type: 04

Sample Date: 88/05/18 Time:

Tot. Cations:

Tot. Anions: 91 me/l Cations:

and total: 91 me/l Anions:

Date of Review and QA Validation

Inorganic Review: 88/06/22

Organic Review:

Radiochemistry Review:

3.0 Microbiology Review:

Laboratory Analyses

Tot. Alk. 152 mg/l

T-Arsenic 24.0 ug/l

T-Cadmium 9.0 ug/l

T-Copper 62.0 ug/l

T-Lead 180.0 ug/l

Mercury <0.2 ug/l

T-Silver <2.0 ug/l

TDS @ 180C

202 mg/l

T-Barium

0.11 mg/l

T-Chromium

<5.0 ug/l

T-Iron

6.6 mg/l

T-Manganese

23.0 ug/l

T-Selenium

<0.5 ug/l

T-Zinc

1300.0 ug/l

PACIFIC PORTAL AT CREEK (MARKINGS WIPED OFF
UNTA NATIONAL FOREST

88 W 100 N

PROVO

UT

84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC PORTAL AT CREEK (MARKINGS WIPED OFF

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802859 Type: 04

Sample Date: 5/18/88 Time:

Tot. Cations:

t. Anions:

and Total:

me/l Cations:

me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk.	164 mg/l	TDS @ 180C	200 mg/l
l-Arsenic	22.5 ug/l	l-Barium	0.28 mg/l
l-Cadmium	33.1 ug/l	l-Chromium	<5.0 ug/l
l-Copper	60.0 ug/l	l-Iron	5.3 mg/l
l-Lead	4000.0 ug/l	l-Manganese	23.0 ug/l
Mercury	0.63 ug/l	l-Selenium	<0.5 ug/l
l-Silver	15.0 ug/l	l-Zinc	1600.0 ug/l

PAC.MINE NW PORTAL PIPED OUT OF MINE
UNITA NATIONAL FOREST
88 W 100 N
PROVO

UT 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PAC.MINE NW PORTAL PIPED OUT OF MINE

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802856 Type: 04

Sample Date: 88/05/18 Time: 10:10

Tot. Cations:

t. Anions: me/l Cations:

and Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk.	198 mg/l	TDS @ 180C	208 mg/l
I-Arsenic	1.0 ug/l	I-Barium	0.15 mg/l
I-Cadmium	<1 ug/l	I-Chromium	<5.0 ug/l
I-Copper	<20.0 ug/l	I-Iron	0.091 mg/l
I-Lead	160.0 ug/l	I-Manganese	19.0 ug/l
Mercury	<0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	78.0 ug/l

88/06/10 13:41

Environmental Chemistry

J80 Page

PACIFIC N TAILING
UNION NATIONAL FOREST
88 W 100 N
PROVO

U1 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: PACIFIC N TAILING
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802860 Type: 04
Sample Date: 88/05/18 Time:
Tot. Cations:
Anions: me/l Cations:
and Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

Tot. Alk.	21 mg/l	TDS @ 180C	140 mg/l
I-Arsenic	90.0 ug/l	I-Barium	0.15 mg/l
I-Cadmium	51.0 ug/l	I-Chromium	<5.0 ug/l
I-Copper	260.0 ug/l	I-Iron	13.0 mg/l
I-Lead	20000.0 ug/l	I-Manganese	48.0 ug/l
Mercury	3.24 ug/l	I-Selenium	1.0 ug/l
I-Silver	45.0 ug/l	I-Zinc	7700.0 ug/l

88/06/22 14:05

Environmental Chemistry

J80 Page:

LOWER PAC.MINE PORTAL ACROSS STREAM FROM BAKE
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603 377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Miller Hill Portal

Description: LOWER PAC.MINE PORTAL ACROSS STREAM FROM BAKE
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802863 Type: 04
Sample Date: 88/05/18 Time: 10:45
Tot. Cations: Date of Review and QA Validation
Inorganic Review: 88/06/22
Organic Review:
Radiochemistry Review:
3.6 Microbiology Review:
Tot. Anions: 109 me/l Cations:
Total: 109 me/l Anions:

Laboratory Analyses

Tot. Alk.	183 mg/l	TDS @ 180C	204 mg/l
T-Arsenic	<1.0 ug/l	T-Barium	0.036 mg/l
T-Cadmium	<1 ug/l	T-Chromium	<5.0 ug/l
T-Copper	<20.0 ug/l	T-Iron	0.048 mg/l
T-Lead	<5.0 ug/l	T-Manganese	6.0 ug/l
Mercury	<0.2 ug/l	T-Selenium	<0.5 ug/l
T-Silver	<2.0 ug/l	T-Zinc	<20.0 ug/l

NORTH FORK AMERICAN RIVER AT DUTCHMAN FLAT
UNITA NATIONAL FOREST
88 W 100 N
PROVO UT 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: NORTH FORK AMERICAN RIVER AT DUTCHMAN FLAT

Site ID: Source: 00

Cost Code: 3508

Lab Number: 8802855 Type: 04

Sample Date: 88/05/18 Time: 16:10

Tot. Cations:

Anions: me/l Cations:

nd Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:

Organic Review:

Radiochemistry Review:

Microbiology Review:

Laboratory Analyses

Tot. Alk.	83 mg/l	TDS @ 180C	102 mg/l
l-Arsenic	2.5 ug/l	l-Barium	0.056 mg/l
l-Cadmium	<1 ug/l	l-Chromium	<5.0 ug/l
l-Copper	<20.0 ug/l	l-Iron	0.45 mg/l
l-Lead	60.0 ug/l	l-Manganese	31.0 ug/l
Mercury	<0.2 ug/l	l-Selenium	<0.5 ug/l
l-Silver	<2.0 ug/l	l-Zinc	77.0 ug/l

88/06/10 13:41

Environmental Chemistry

JBO Page

MARY ELLEN PORTAL
UINTA NATIONAL FOREST
88 W 100 N
PROVO

U1 84603

377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN PORTAL
Site ID: Source: 00
Cost Code: 3508
Lab Number: 8802858 Type: 04
Sample Date: 88/05/18 Time: 15:00
Tot. Cations:
Anions: me/l Cations:
Total: me/l Anions:

Date of Review and QA Validation

Inorganic Review:
Organic Review:
Radiochemistry Review:
Microbiology Review:

Laboratory Analyses

Tot. Alk.	36 mg/l	TDS @ 180C	206 mg/l
I-Arsenic	100.0 ug/l	I-Barium	0.019 mg/l
I-Cadmium	0.4 ug/l	I-Chromium	<5.0 ug/l
I-Copper	40.0 ug/l	I-Iron	9.9 mg/l
I-Lead	10.0 ug/l	I-Manganese	140.0 ug/l
Mercury	<0.2 ug/l	I-Selenium	<0.5 ug/l
I-Silver	<2.0 ug/l	I-Zinc	1200.0 ug/l

88/06/22 14:05

Environmental Chemistry

JBO Page

MARY ELLEN CREEK 1/4 MILE BELOW MINE AREA
UINTA NATIONAL FOREST
88 W 100 N
PROVO UT 84603 377-5780

UTAH STATE HEALTH LABORATORY
Environmental Chemistry Analysis Report

Description: MARY ELLEN CREEK 1/4 MILE BELOW MINE AREA
Site ID: Source: 00
Cost Code: 350B
Lab Number: 8802861 Type: 04
Sample Date: 88/05/18 Time: Date of Review and QA Validation
Inorganic Review: 88/06/22
Organic Review:
Radiochemistry Review:
1.8 Microbiology Review:
Total Cations: 55 me/l Cations:
Total Anions: 55 me/l Anions:

Laboratory Analyses

Total Alk.	92 mg/l	IDS @ 180C	132 mg/l
T-Arsenic	<1.0 ug/l	T-Barium	0.039 mg/l
T-Cadmium	2 ug/l - ?	T-Chromium	<5.0 ug/l
T-Copper	42.0 ug/l	T-Iron	1.1 mg/l
T-Lead	40.0 ug/l	T-Manganese	46.0 ug/l
Mercury	<0.2 ug/l	T-Selenium	<0.5 ug/l
T-Silver	<2.0 ug/l	T-Zinc	310.0 ug/l



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College of Agriculture

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Phone: (307) 766-3103
Fax: (307) 766-3379

24 July, 1992

Mr. Paul Skablund
Hydrologist
Uinta National Forest
88 West 100 North
Provo, UT 84601

UINTA NATIONAL FOREST

JUL 29 1992

Dear Mr. Skablund:

We would like to inform you of a research project that will likely be of significant interest to your organization. As you well know, mitigation of water pollution in the western United States is a matter of increasing concern. In particular, the mitigation of heavy-metal contaminated mineland effluent is an area of intense environmental interest. Heavy-metal effluent from hard rock mines at high elevations presents unique challenges in terms of cost, accessibility, and ecological damage. However, in the last two years we have succeeded in the first phase of a three phase program to develop a wetland system capable of effectively treating effluents which contain a range of heavy metals.

We have discovered a number of plants that accumulate heavy metals, including arsenic, lead, copper, zinc, and cadmium). Our reference metal, copper, is accumulated at a concentration 1,000 to 4,000 times that found in the water; one remarkable sedge that grows in the Rocky Mountains accumulates over 25,000 times the background concentration of this metal. All of these plants have been successfully cultivated in the greenhouse, where we are continuing to study the ecological parameters which optimize accumulation rates. In addition, we have found two fungi that are capable of removing 30-40% of the heavy metal from a liquid medium contaminated with 100 ppm copper in 9 days. The primary mechanism of removal appears to be metabolic chelating of the metal, which has particularly promising applications for *in situ* mitigation.

The next phase of our work will be small-scale experimental wetlands on contaminated mine sites. These "micro"-wetlands will be used to systematically vary ecological conditions and plant/fungi associations to determine the optimal system for heavy metal mitigation at a particular site. The final phase will involve the full-scale development of a wetland or series of wetlands capable of providing effective treatment of contaminated effluent. At this time, we are seeking funding for the initiation of the last two phases of this program. It appears that most, high altitude habitats would be amenable to this treatment program, and we are highly optimistic that mitigative wetlands will provide an extremely cost-effective management tool.

Enclosed you will find a more detailed presentation of the results to date and our future plans. If you are interested in further information or discussing the possibility of full or partial funding, please write to us or call (307) 766-3103 and ask for any of us.

Sincerely,

Stephen E. Williams
Professor,
Soil Science

Nancy K. Culp
Research Associate,
Plant Science

Jeffrey A. Lockwood
Associate Professor,
Entomology

Title Development of High Mountain Plant Communities as
Wetland Mitigation Systems for Heavy Metal Mine
Effluent.

Present Duration January 1991 - February 1993

Background

Heavy metal pollution from mine effluent is a serious and widespread problem in the western states. Although considerable work has documented the impact of heavy metals on aquatic and riparian flora, prior to our research there were no published, comprehensive field studies of the impacts of metals on high mountain stream plant communities. As a consequence the potential for manipulating high-elevation wetland plants and fungi for mitigation of mine effluent was unknown, although plant communities had proven to be effective filters of heavy metals in other ecosystems (Cairns 1980, Brooks et al. 1985).

It is well known that wetland plants can act as pollutant filters, collecting and holding nutrients, sediment, silt and other natural and anthropogenic pollutants, including heavy metals. There are several reasons why heavy metals are trapped in wetlands. Some metals will precipitate in the anaerobic zone, commonly present in wetlands. The high levels of decaying organic matter will further chelate many of these same metals. Many plants and microbiotic organisms that tolerate heavy metals also accumulate them in their tissues. At low elevations, the value of wetlands in sequestering iron and manganese from mine drainages has already been recognized (Holbrook and Maynard 1985, Gerber et al. 1985), and efforts have been made to construct wetlands for the purpose of trapping heavy metals (Gerber et al. 1985).

An effort to use wetlands to mitigate heavy metal mine discharge in high mountain streams is unique in that: 1) most wetland projects on abandoned mine lands have had the restoration of wildlife habitat, not mitigation of effluent, as the primary goal (Taub 1969, Brooks et al. 1985, Cairns 1987), 2) no wetland restoration projects have been developed at high elevations, and 3) wetland projects have been used to mitigate impacts of acids, iron and manganese, but the management of copper, zinc, lead and arsenic has not been attempted. Effective mitigation of mine effluent with wetlands generally includes integration of physical, chemical, and biological parameters (Brooks et al. 1985). In this context, it seems unlikely that manipulation of wetlands alone will completely reduce the heavy metal content of mine effluent flows. However, strategic management of plant and fungal communities is likely to play a significant role in a comprehensive ecological effort (e.g., settling ponds, impoundment, precipitation, etc.). Following physical, chemical, and biological treatments, wetland systems may be expected to function effectively in a management program.

Objectives

This wetland mitigation project has been in progress for 1.5 years. To date, the objective of this study has been to discover wetland plants and fungi that could tolerate and sequester heavy metals in their tissues. Both the plants and the environments in which they reside were examined. Reproductive and growth requirements were investigated.

Site Selection

During the summer of 1992, sites were assessed for their potential use in this study. Elevation, presence of mine effluent flowing across fairly horizontal gradients that contained wetland plants and accessibility were the main criteria used for selecting the areas. The sites chosen for study in summer 1992 were as follows, 1) Hughesville-Barker Block P Mine and Mill tailings in Lewis and Clark National Forest, Montana, 2) The Ontario Mine in Helena National Forest, 3) The Independence and McClaren mines in Gallatin National Forest, Montana, 4) Kirwin Mine west of Meeteetse in Wyoming, 5) Ferris-Haggarty Mine in the Sierra Madres, southern Wyoming, 6) Pacific and Mary Ellen Mine in the Wasatch Mountains, Utah. Additional sites that were assessed but rejected for the purposes of this study were the Mike Horse Mine in Helena National Forest, Montana and the Lower Bog Mine in the Wasatch Mountains, Utah.

Methods

Community and habitat analysis were undertaken on the chosen study sites. The Daubenmire quadrat method was used to identify the dominant and subdominant species. Diversity was quantified by counting number of plant species per site. The site was mapped on a 7.5 minute quad. Slope and aspect were determined with a clinometer and compass. The topographic position of the site was determined (crest, upper slope, mid-slope, lower slope, valley bottom, bench or terrace, saddle or gap). It was determined whether lighting was open, partial, filtered, or shaded on the site. Soil moisture was described as inundated (hydric), saturated (wet-mesic), moist (mesic), dry-mesic, or dry (xeric). Elevation was determined using a topographic map. The environment of the site was described (sand or gravel bar; wet meadow dominated by grasses; marsh dominated by sedges or rushes; swamp dominated by shrubs or trees; bog mire [mosses in acidic, wet peat soil]; fen mire with vascular plants in alkaline, wet peat soil; swale with moist surface soil; seep; terrace within three vertical feet or 100 feet of running surface water; snow catchment area; floating or quaking vegetation mat). Soil was collected to quantify pH, N, P, K and heavy metal composition. It was also collected for mycological sampling. The pH of the water on each site was tested, and samples were collected for heavy metal analysis in the laboratory.

Voucher specimens were collected of all the different species on each site. Vigor was described for each species. The reproductive fitness of each species in the most heavily impacted area was ascertained. Evidence of hybridity, disease, and symbiotic or parasitic relationships was noted. Plants were collected for heavy metal analysis, copper toxicity and reproductive studies in the greenhouse.

Vascular plants were identified using the Rocky Mountain Herbarium. Mosses were sent to the Clinton Herbarium in Buffalo, New York, to be identified. The pH, N, P, and K of the soil was determined by using a LaMotte soil testing kit. Plant available heavy metals were extracted from the soils using the ABDTPA method (Soltanpour and Schwab, 1977). Heavy metals were extracted from the plants via nitric acid digests (Havlin and Maynard, 1985). The University of Wyoming soil-testing lab analyzed duplicate samples of the water, soil and plants for Cu, Zn, Cd, Pb, Hg and As via inductively coupled plasma spectrometry.

Soil fungi from mines with soils containing more than 100 ppm of copper were plated on an agarose medium containing 100 ppm of copper and analyzed for frequency and dominance. Dominant and subdominant species were identified. Dominant species were grown in a liquid medium containing between 80 and 100 ppm of copper. The medium was analyzed for copper before inoculation and after a period of nine days. The fungi that grew in the culture was also analyzed after nine days.

Summary of Project Work Done to Date

To date, this study has shown that wetlands containing both plant and fungal species can be used very effectively to prevent release of heavy metals into stream systems. Both abiotic and biotic factors act to prevent the movement of heavy metals. Soils, especially those high in organic matter, and of fine particle size, chelate heavy metals and hold them in place. Notable in our study was the fact that the soils found directly under the plants contained higher levels of heavy metals, than those soils which were bare (ranging from 2:1 at the Ontario Mine to 24:1 at Ferris-Haggarty). Plants also uptake these metals, preventing their escape.

In this study, many plants were shown to substantially accumulate various heavy metals. All species accumulated significant amounts of heavy metals relative to the amounts found in water. For copper, the highest accumulators in context of background levels in water and soil, were *Pohlia annotina* (a moss) accumulating 3,000 times the amount in water, and 48 times the amount in soil, *Deschampsia cespitosa* (a grass) accumulating 2,000 times the level in water, and 31 times the soil, *Pohlia wahlenbergii* (a moss) accumulating 14,800 times the level of copper in the water, and 7 times the background soil level, and *Senecio fremontii* (a forb) accumulating 31 times the level in water and 5 times the soil level.

For zinc, the highest accumulators were *Pohlia wahlenbergii* (a moss) accumulating 3,800 times the level in water and 10 times the soil level, *Equisetum arvense* (a horsetail) accumulating 1,100 times the amount of zinc in the water and 8 times the amount in the soil, *Poa interior* (a grass) accumulating 2,100 times the level in the water and 6 times the soil background level, and *Agrostis exarata* (a grass) accumulating 260 times the zinc level in the water, and 4 times the soil level.

The highest lead accumulators were *Carex microptera* (a sedge) accumulating 6,000 times the level in the water, and 3,000 times the soil, and *Poa interior* (a grass) accumulating 5,300 times the amount in the water, and 2,700 times the soil level.

Arsenic was most effectively accumulated in *Pohlia wahlenbergii* (a moss). It accumulated 3,200 times the level of arsenic in the water, and 1,100 times the soil level, *Bryum lisae* (a moss) contained 6,400 times the amount in the water, and 1,100 times the level in the soil, *Epilobium glaberrimum* (a forb) accumulated 5,800 times the amount in the water, and 1,000 times the soil level, and *Carex scopulorum* (a sedge) accumulated 26,400 times the amount in the water and 113 times the soil level.

Cadmium was accumulated best by *Pohlia wahlenbergii* (a moss) at 6,400 times the level in the water, and 2 times the level in the soil.

All of these plants were capable of accumulating multiple metals. The highest overall accumulator was *Pohlia wahlenbergii*. Plants were able to accumulate arsenic most effectively, followed by lead, copper, zinc and finally cadmium. Different species varied in their ability to accumulate different heavy metals, so a mix of different species would be best for introduction into man-made wetlands, where a spectrum of contaminants is present.

Deschampsia cespitosa was common on all of the copper sites. *Carex aquatilis*, and *Pohlia nutans* tolerated both zinc and copper sites. *Carex microptera* was common on sites which were high in zinc, and *Carex rostrata* appeared on zinc, lead and arsenic contaminated sites.

All of the plants that were collected in the field have been established in the greenhouse. The seeds of sedges that were collected germinated fully within 6 days, after 2 months of cold stratification. Germination was poor and occurred over a period of 6 weeks to 3 months without stratification. The seeds of the *Epilobiums* germinated in 3-6 days without stratification. Mosses have survived well within misting benches or where humidity is kept at high levels. Laboratory toxicity studies have shown that all of the species will survive well in the most copper-polluted sites found during our study. Although we have yet to find the extreme level of copper fatal to the plants, this is clearly far above that present in the field.

All of the fungal species analyzed accumulated copper. These included *Tolypocladium inflatum*, *Trichocladium* sp., and *Penicillium* sp. nov. "A". *Tolypocladium inflatum* from the Ferris-Haggarty Mine accumulated an average of 2,800 ppm of copper. *Tolypocladium inflatum* from the Kirwin Mine accumulated 3,400 ppm of copper. *Trichocladium* sp. from the McClaren's Mine at Cooke City, MT accumulated an average of 900 ppm and *Penicillium* sp. nov. "A" from the Pacific Mine in Utah accumulated 1,600 ppm of copper. These amounts were accumulated out of 80-95 ppm copper-amended medium. The accumulation of the copper in the fungi did not account for all or most of the copper removed from the medium by *Tolypocladium inflatum* and *Trichocladium* sp. In the case of *Tolypocladium inflatum*, an average of 41% of the copper had been removed from the solution by the fungus at the end of the 9 day experimental period. Of the copper that was removed, 77% was removed by a mechanism other than accumulation by the fungi. *Trichocladium* sp., removed an average of 31% of the copper from the solution. Of this, only 3% was found in the fungus; the remaining 97% was taken out of solution by another mechanism. Based on the scientific literature, we hypothesized that both species are producing a metabolite that is chelating the copper and removing it from the solution. As such, the potential for fungi to play a significant role in copper mine effluent mitigation appears reasonably high.

Studies to be completed before February 1993

Field work for the summer of 1993 is in progress. The accumulation of heavy metals in the dominant species of plants on three study sites, over space and time is being examined at the Ontario Mine in Montana and the the Kirwin and Ferris-Haggarty mines in Wyoming. The shoots and roots of plants collected are being separated for heavy metal analysis, to examine possible impacts on wildlife. Seeds of candidate plants for wetland mitigation studies will be collected from the Pacific Mine in Utah. Growth and copper toxicity studies are being completed in the greenhouse. Studies of environmental parameters (pH and temperature) that may effect uptake of heavy metals by plants will be attempted in the fall. Analysis of the fate of copper after senescence of the plant will also be undertaken at this time. In vitro fungal studies to determine the mechanism of copper removal are continuing. A two year report of the project will be submitted to the Department of Environmental Quality, Abandoned Minelands by December 1st, 1992.

Proposed work after February 1993

The present research is designed to produce the technology necessary for wetland mitigation of copper mine effluent. The main reason we are working on copper pollution is because of the serious environmental situation that exists at the Ferris-Haggarty mine in the Sierra Madres, Wyoming. However, in our study we have discovered that there were few mines in the west where the main contaminant in the effluent was copper. Many abandoned mines have effluent flows containing higher levels of zinc, lead or arsenic with copper as a secondary contaminant. All of the mines studied contained heavy metals in combination. To design wetland mitigation systems for these mines' effluents, it would be advisable to initiate plant and fungal studies of the other metals present on these mine sites, similar to what has been done with copper. The effects of these metals in combinations similar to what is present in the field should also be examined.

It would be useful to establish control sites that are similar in every other way to the heavy metal polluted sites so that variations between polluted and unpolluted sites could be analyzed. Study sites already established can be analyzed for ecological parameters over several summers.

Small-scale field studies should be initiated at a site before a full-blown wetland mitigation project is undertaken. Problems encountered in the small scale in situ studies can be solved before large monetary commitments are made. These field studies will be in the form of micro-wetlands created by shunting a part of a mine effluent flow into a level, dyked area. Each micro-wetland will have parameters varied using a statistically valid experimental design to optimize the information gained (plant assemblage, inoculation by fungi, soil amendments). Data will be gathered throughout the field season (see attached diagram of possible study design). The Ferris-Haggarty, Kirwin, Ontario, Mary Ellen, and/or Pacific mines would be good sites to set up these microwetlands, if owner permission can be obtained.

The possibility of using tolerant species of fungi for treatment of heavy metal mine effluent should be explored. The prospect of both mitigating heavy metal contaminated mine effluent and recovering heavy metals from some of the fungal species that we have discovered during this study is exciting. This primary treatment system could prove to be relatively low in initial cost and long-term maintenance.

Literature Cited

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UINTA NATIONAL FOREST

JUN 01 1992

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Fax: (307) 766-3379

30 May 1992

Uinta National Forest Supervisor's Office
Paul Skablund
Forest Hydrologist
88 West 100 North
Provo UT 84601

Dear Mr. Skablund:

Here is your part of the year-end report on the mitigation of heavy metal mine effluent by wetlands, that I promised you. I hope you will find the data I gathered at the Pacific and Mary Ellen mines informative. If you need any more information, please call me.

If it is all right with you, I would like to visit the Pacific Mine sometime in late August or September to gather seed heads off of the plants up there. I am going to grow larger amounts of these plants in the greenhouse for use in wetland mock-up studies. I will send you the data I gather from these studies.

I hope you will gain some insight from this report. The beaver pond at the Pacific Mine is doing a great deal to mitigate flow-through of heavy metals into the North Fork of the American Fork River. I am glad to hear that you are trying to keep people off of the mine tailings. They are heavily laced with a variety of heavy metals and probably would not be good for the health of anybody who spent a lengthy period of time on them, especially on a windy day.

Thank-you for your consideration,

Nancy Kastning-Culp
Research Associate

Year End Report

On Mitigation Systems for Hard Rock Mine Effluent
In Utah

Investigators:
Nancy Kastning-Culp
Larry DeBrey
Jeff Lockwood
of the
Department of Plant, Soil and Insect Sciences
University of Wyoming

30 May 1992

Abstract/Summary of All Mines Studied

This study shows that wetlands can be used very effectively to prevent release of heavy metals into stream systems. Both abiotic and biotic factors act to prevent the movement of heavy metals. Soils, especially those high in organic matter, and of fine particle size, chelate heavy metals and hold them in place. Notable in our study was the fact that the soils found directly under the plants contained higher levels of heavy metals, than those soils which were bare (a minimum of 2:1 at the Ontario Mine, maximum 24:1 at Ferris-Haggarty). Plants also uptake these metals, preventing their escape.

In this study, many plants were shown to accumulate various heavy metals to a great degree. All species accumulated significant amounts of heavy metals in comparison to the amounts found in water. For copper the best accumulators as compared to background levels in water and available in soil, were Pohlia annotina (a moss) accumulating 3,032 times the amount in water, and 48 times the amount in soil, Deschampsia cespitosa (a grass) accumulating 1,979 times the level in water, and 31 times the soil, Pohlia wahlenbergii (a moss) accumulating 14,813 times the level of copper in the water, and 7.0 times the background soil level, and Senecio fremontii (a forb) accumulating 31 times the level in water and 5 times the soil level.

For zinc, the best accumulators were Pohlia wahlenbergii (a moss) accumulating 3,814 times the level in water and 10 times the soil level, Equisetum arvense (a horsetail) accumulating 1,120 times the amount of zinc in the water and 7.5 times the amount in the soil, Poa interior (a grass) accumulating 2,128 times the level in the water and 5.7 times the soil background level, and Agrostis exarata (a grass) accumulating 261 times the zinc level in the water, and 4.5 times the soil level.

The best lead accumulators were Carex microptera (a sedge) accumulating 5,954 times the level in the water, and 2,977 times the soil, and Poa interior (a grass) accumulating 5,347 times the amount in the water, and 2,674 times the soil level.

Arsenic accumulated best in Pohlia wahlenbergii (a moss). It accumulated 3,221 times the level of arsenic in the water, and 1,073 times the soil level, Bryum lisae (a moss) contained 6,443 times the amount in the water, and 1,073 times the level in the soil, Epilobium glaberrimum (a forb) accumulated 5,814 times the amount in the water, and 969 times the soil level, and Carex scopulorum (a sedge) accumulated 26,432 times the amount in the water and 113 times the soil level. Cadmium was accumulated best by Pohlia wahlenbergii (a moss) at 6,393 times the level in the water, and 1.7 times the level in the soil.

All of these plants were capable of accumulating multiple metals. The best overall accumulator was Pohlia wahlenbergii. Plants were able to uptake arsenic most effectively followed by lead, copper, zinc and then cadmium. Different species vary in their ability to accumulate different heavy metals, so a mix of different species would be best for introduction into man-made wetlands, where a range of contaminants is present.

Deschampsia cespitosa was common on all of the copper sites. Carex aquatilis, and Pohlia nutans tolerated both zinc and copper sites. Carex microptera was common on sites which were high in zinc, and Carex rostrata appeared on zinc, lead and arsenic sites.

Field and Lab Methods

In the field, community and habitat analyses were undertaken. The Daubenmire quadrat method was used to identify the first and second most dominant species. Diversity was quantified by counting number of species per site. The site was mapped on a 7.5 minute quad. Slope and aspect were determined with a clinometer and compass. The topographic position of the site was determined (crest, upper slope, mid-slope, lower slope, valley bottom, bench or terrace, saddle or gap). It was determined whether lighting was open, partial, filtered, or shaded on the site. Soil moisture was described as inundated (hydric), saturated (wet-mesic), moist (mesic), dry-mesic, dry (xeric). Elevation was determined using a topographic map. The environment of the site was described (sand or gravel bar; wet meadow dominated by grasses; marsh dominated by sedges or rushes; swamp dominated by shrubs or trees; bog mire [mosses in acidic, wet peat soil]; fen mire with vascular plants in alkaline, wet peat soil; swale with moist surface soil; seep; terrace within three vertical feet or 100 feet of running surface water; snow catchment area; floating or quaking vegetation mat). We collected soil to quantify pH, N, P, K and heavy metal composition. We also collected soil for mycological sampling (10 samples from the most heavily impacted site). We tested the pH of the water on the site before collecting it for heavy metal analysis in the lab.

Voucher specimens were collected of all the different species on the site. Vigor was described for each species. The reproductive fitness of each species in the most heavily impacted area was ascertained. We looked for evidence of hybridity, disease, and symbiotic or parasitic relationships. We then collected plants for heavy metal analysis and live-plant greenhouse studies.

Vascular plants were identified using the microscopes at the Rocky Mountain Herbarium. Mosses were sent to the Clinton Herbarium in Buffalo, New York, to be identified by Patricia Eckel, a western moss specialist. The pH, N, P, and K of the soil was determined by using a LaMotte soil testing kit. Plant available heavy metals were extracted from the soils using the ABDTPA method (Soltanpour, 1977). Heavy metals were extracted from the plants via nitric acid digests (Havlin, 1980). The University of Wyoming soil-testing lab analyzed duplicate samples of the water, soil and plant samples for Cu, Zn, Cd, Pb, Hg and As using an inductively coupled plasma spectrometer.

Mycological soil samples from Kirwin Mine and Ferris-Haggarty Mine in Wyoming, McClaren's Mine in Montana, and the Pacific Mine in Utah were diluted 1:100 in sterile, deionized water, and 1 ml each of each sample was dispensed onto three plates of 10, 100, and 1000 ppm copper-enriched Martin's Medium. Colonies were counted and hyphal tip picks were made from the 100 ppm copper-enriched Martin's into 100 ppm copper enriched potato-dextrose agar tubes.

Utah

Mary Ellen Mine - Wasatch Mountains - ^{Utah} Wasatch County

*Glacial
Trough or
Valley*

The Mary Ellen mine is 2.1 miles up a four wheel drive road. It is in a cirque basin surrounded by peaks of the Wasatch mountains. The Mary Ellen gulch area was extensively mined. Mine effluent originates from the side of a hill, flows past tailings piles and into Mary Ellen Creek. Forest service tests in 1981 and 1982 show zinc to be the main contaminant followed by copper. The soil around and under the effluent is stained a bright orange-red. Several plants grow directly in and by the effluent including a moss, Epilobium (a willow-wort), Mimulus (also called monkey-flower), Carex (a sedge), and Juncus (a rush). See Figure 3 for the map of the Mary Ellen microsite.

Microsite Information:

Microsite Code: ME1

UT : Utah County. Wasatch Mountains ca 20 air miles north of Provo, ca 1 air mile east-south-east of East Twin Peak at the Mary Ellen Mine seep (T3S R3E S22). From Provo: Go to American Fork Canyon. Follow road to Dutchmans Flat. Go up the center 4 wheel drive road into Mary Ellen Gulch. You should be on the right side of the creek. Turn left at all forks. The road dead ends into the mine.

Habitat and Community Information:

This site is located at mid-slope by a seep. The elevation is 9,500 ft. The slope is facing south-east. Lighting is full.

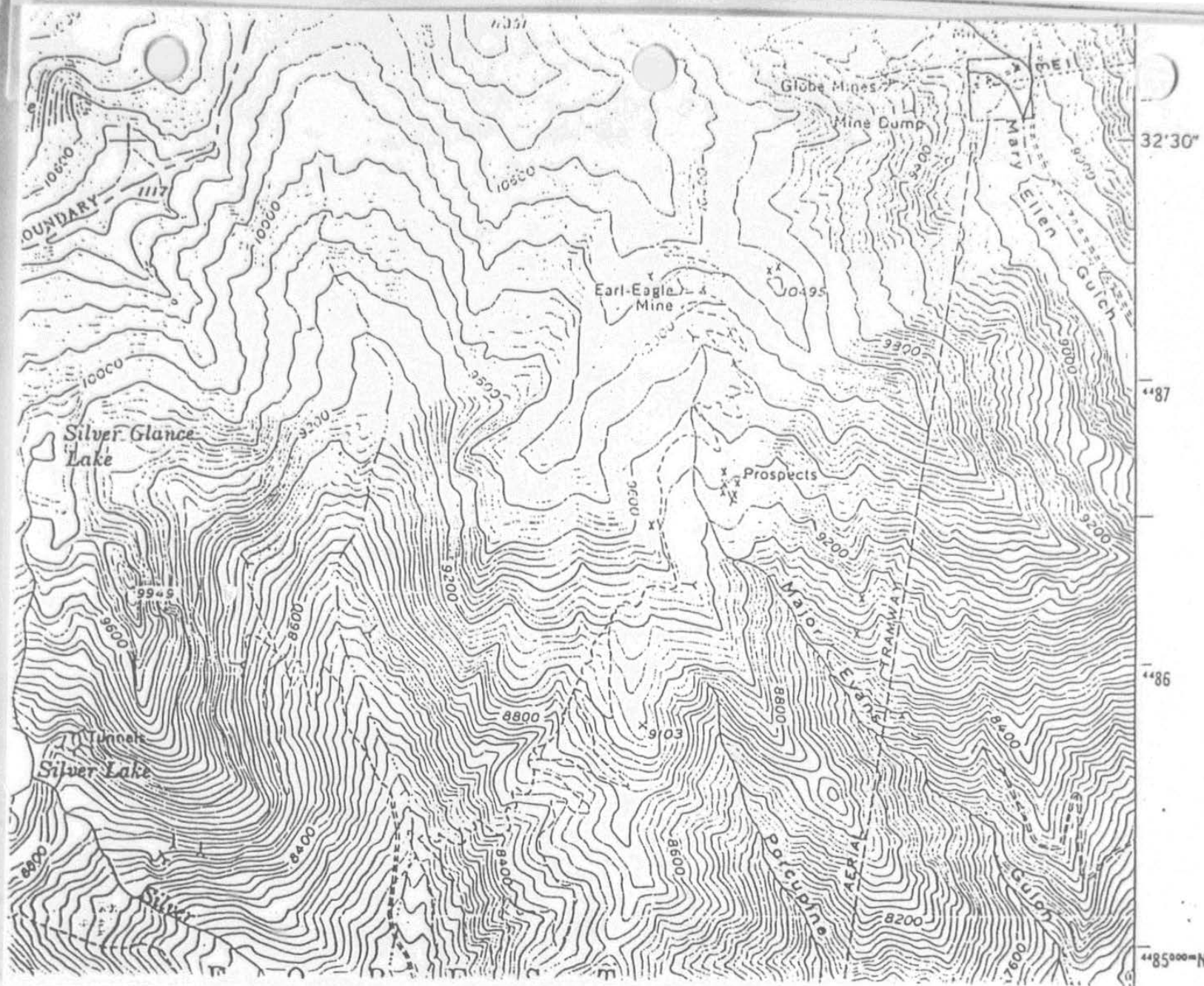
Basic soil and water chemistry:

pH of Water: 6 Soil pH: 6 N: 5ppm P: 50ppm K: <50ppm

The dominant species is Bryum lisae var. cuspidatum (a moss) and Poa interior (a grass) is subdominant. Nine species were sampled by quadrat on this site.

Figure 3

Map of Mary Ellen Microsite



Individual Species Information:

Chem Code: ME1BL

Species: Bryum lisae
var. cuspidatum

Date collected: 07/30/91

Vigor: Exceptionally vigorous Cover: 65 % Frequency: 90 %

Chem Code: ME1CC

Species: Corydalis caseana

Date collected: 07/30/91

Vigor: vigorous

Cover: 0 % Frequency: 0 %

Comments: This species did not appear in thrown quadrats.

Chem Code: ME1CM

Species: Carex microptera

Date collected: 07/30/91

Vigor: vigorous

Cover: 0 % Frequency: 0 %

Comments: This species did not appear in thrown quadrats.

Chem Code: ME1EG

Species: Epilobium glaberrimum

Date collected: 07/30/91

Vigor: Vigorous

Cover: 0 % Frequency: 0 %

Comments: This species did not appear in thrown quadrats.

Chem Code: ME1PI

Species: Poa interior

Date collected: 07/30/91

Vigor: Normal

Cover: 6 % Frequency: 20 %

Heavy Metal Chemistry (mg/kg):

Plants:

Date:	07/30/91	Code:	ME1BL	<u>Bryum</u>	<u>lisae</u>	
Cu	Zn	Cd	Pb	Hg	As	
256.5	1249.5	17.66	191.5	<5	644.2	

Date:	07/30/91	Code:	ME1CC	<u>Corydalis</u>	<u>caseana</u>	
Cu	Zn	Cd	Pb	Hg	As	
39	295.5	2.475	39.05	<5	87	

Date:	07/30/91	Code:	ME1CM	<u>Carex</u>	<u>microptera</u>	
Cu	Zn	Cd	Pb	Hg	As	
101	332	2.975	54.55	<5	70.95	

Date:	07/30/91	Code:	ME1EG	<u>Epilobium</u>	<u>glaberrimum</u>	
Cu	Zn	Cd	Pb	Hg	As	
186.5	1047	13.65	99.3	<5	581.35	

Soil:

Date:	06/25/91	Code:	ME1S	By Mary Ellen seep		
Cu	Zn	Cd	Pb	Hg	As	
30.76	435.96	3.84	<.2	<.2	.6	

Water:

Date:	06/25/91	Code:	ME1W	Mary Ellen mine effluent		
Cu	Zn	Cd	Pb	Hg	As	
.02	1.55	<.01	<.1	<.1	<.1	

These plants accumulated high levels of both zinc and arsenic.

Bryum lisae (a moss) accumulated 806 times the amount of zinc in the water, and 2.9 times the amount of zinc in the soil. It accumulated 6,442 times the amount of arsenic in the water and 1,074 times the amount of arsenic in the soil. It also accumulated copper at a rate 8.3 times the level in the soil, and 12,825 times the level in the water.

Epilobium glaberrimum (a willow-wort) accumulated 675 times the amount of zinc in the water and 2.4 times the amount of zinc in the soil. This plant accumulated 5,814 times the amount of arsenic as in the water, and 969 times the amount of arsenic in the soil. It also contained 6.06 times the amount of copper in the soil and 9,325 times the level in the water.

Pacific Mine - Wasatch Mountains

The Pacific Mine is located on the left fork of the main dirt road originating from Tibble Fork Reservoir. The mine effluent originates from a hillside, pools in a flat area, and flows through a tailings pile before entering into a beaver-caused wetlands complex. This area is a perfect study site in which to test the hypothesis that wetlands systems which include heavy metal tolerant or accumulating species of plants would mitigate heavy metal effluent. In fact, University of Wyoming water quality studies indicate that water quality increases dramatically after running through the wetlands and beaver dam. This site also yielded the species which accumulated the most heavy metals. Pohlia wahlenbergii var. glaciale (a moss) accumulated 13,004 ppm of zinc. This is 3,813 times the background water level and 10 times the background soil levels. This moss also accumulated 1,185 ppm of copper, which is 1,481 times the background level of water and 7 times the background level of the soil. All of the metals for which we tested were accumulated by this plant. The area impacted by the mine drainage is rich in vegetation, including two species of Carex (a sedge), a species each of Juncus (a rush), Poa (a grass), and Epilobium (a willow-wort), and a species of moss. The main contaminant in the effluent is zinc. See Figure 4 for map of Pacific Mine microsites.

Microsite Information:

Microsite Code: PM1

UT : Utah County. Wasatch Mountains ca 20 air miles north-north-east of Provo, ca 1 air mile west of Miller Hill at the Pacific Mine (T3S R3E S22). From Provo: Go to American Fork Canyon. Follow the road to its main fork above all named flats and go left. The Pacific Mine is on the left approximately 1 mile up the road. This microsite is the seep mouth on the Pacific Mine.

Habitat and Community Information:

This site is located on a lower slope by a seep. The elevation is 7,800 ft. The slope is east-facing. Lighting is Full.

Basic soil and water chemistry:

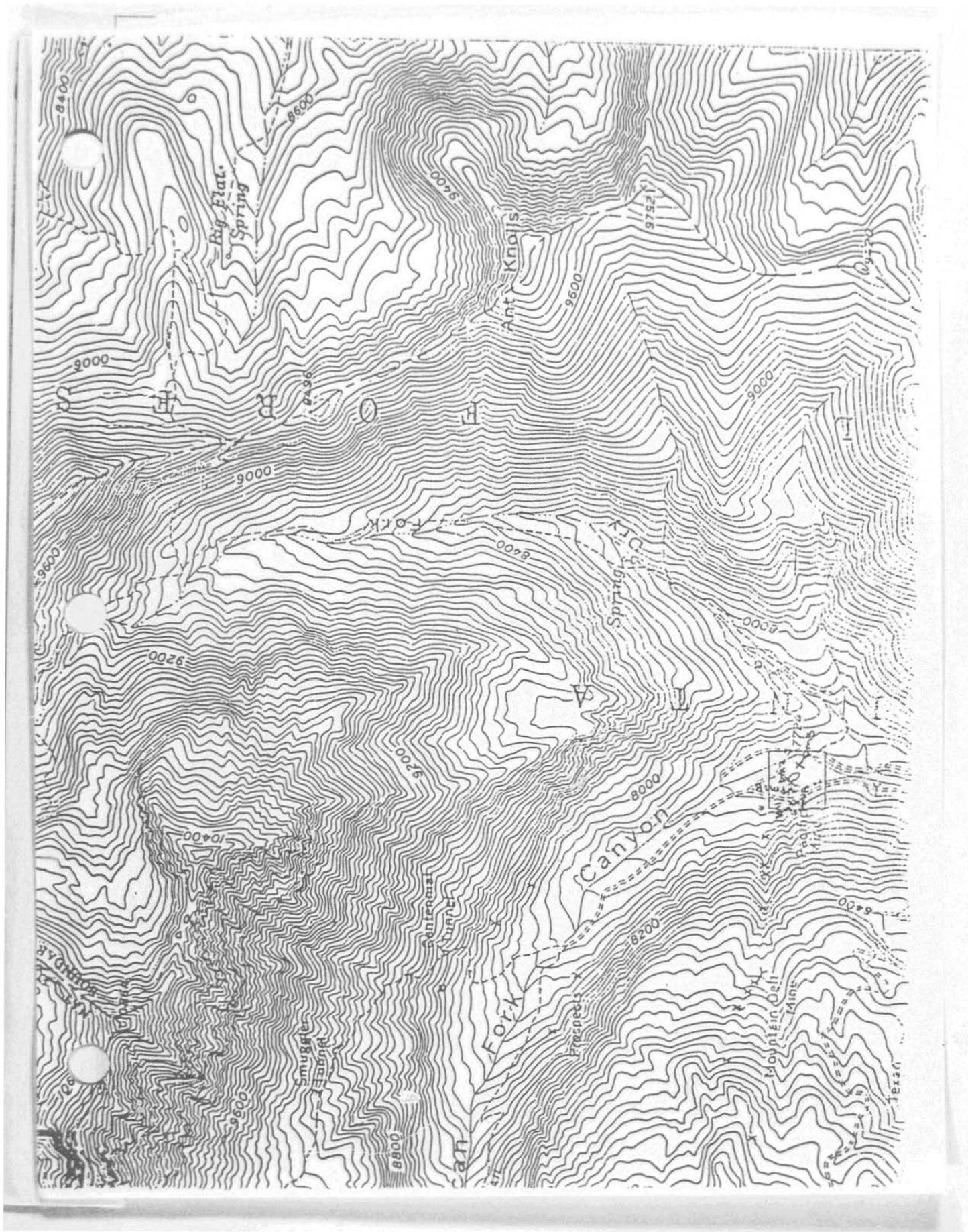
pH of Water: 6 Soil pH: 7 N: 20ppm P: 25ppm K: 150ppm

The dominant plant species is Carex microptera (a sedge), and Juncus ensifolius (a rush) is subdominant. Seven species were sampled by quadrat on this site.

The dominant soil microfungi is

Figure 4

Map of Pacific Mine Microsites



Individual Species Information:

Chem Code: PM1CM

Species: Carex microptera

Vigor: Vigorous

Date collected: 07/31/91

Cover: 37 %

Frequency: 40

Chem Code: PM1JE

Species: Juncus ensifolius

Vigor: Vigorous

Date collected: 07/31/91

Cover: 26 %

Frequency: 30 %

Chem Code: PM1PW

Species: Pohlia wahlenbergii
var. glaciale

Date collected: 07/31/91

Vigor: exceptionally vigorous

Cover: 3.4%

Frequency: 20 %

Comments: This moss is especially loaded with heavy metals.

Chem Code: PM1PI

Species: Poa interior

Vigor: Vigorous

Date collected: 07/31/91

Cover: 8 %

Frequency: 20 %

Heavy Metal Chemistry (mg/kg):

Plants:

Date:	07/31/91	Code:	PM1CM	<u>Carex microptera</u>
Cu	Zn	Cd	Pb	Hg As
556.5	5403	69.97	595.35	<5 305.15

Date:	07/31/91	Code:	PM1JE	<u>Juncus ensifolius</u>
Cu	Zn	Cd	Pb	Hg As
237	2662.5	28.64	242.35	<5 171.85

Date:	07/31/91	Code:	PM1PI	<u>Poa interior</u>
Cu	Zn	Cd	Pb	Hg As
724.5	7259	79.83	534.7	<5 489.9

Date:	07/31/91	Code:	PM1PW	<u>Pohlia wahlenbergii</u>
Cu	Zn	Cd	Pb	Hg As
1185	13004	127.86	388.05	<5 644.25

Soil:

Date:	07/31/91	Code:	PM1S	Pacific mine seep
Cu	Zn	Cd	Pb	Hg As
166.96	1261.96	74.99	<.2	<.2 .6

Water:

Date:	06/25/91	Code:	PM1W	At effluent mouth
Cu	Zn	Cd	Pb	Hg As
.12	4.64	<.01	<.1	<.1 <.1

Date:	07/31/91	Code:	PM1W	At effluent mouth
Cu	Zn	Cd	Pb	Hg As
.08	3.41	.02	.1	<.1 .2

Date:	07/31/91	Code:	PM1WA	effluent pool below mouth
Cu	Zn	Cd	Pb	Hg As
.08	3.32	.01	.1	.1 .1

Date:	07/31/91	Code:	PM1WB	Below tailings before dam
Cu	Zn	Cd	Pb	Hg As
.58	14.7	.11	.6	.4 <.1

The Pacific Mine had unusually high amounts of copper, zinc, lead and cadmium. Some arsenic and mercury were also present.

Pohlia wahlenbergii (a moss) accumulated notable levels of copper, zinc and arsenic. It accumulated 14,813 times the background level of copper in the water, and 7.1 times the amount in the soil. It also accumulated 3,814 times the amount of zinc in the water and 10.3 times more than the amount in the soil. Arsenic was accumulated at 3,221 times what was in the water and 1,074 times the amount in the soil.

Carex microptera (a sedge) accumulated notable levels of copper, zinc and lead. It accumulated 6,956 times the amount of copper as was in the water, and 3.33 times what was in the soil. Zinc was accumulated at 1,584 times what was in the water, and 4.28 times what was in the soil. Lead accumulated at 5,954 times the amount in the water and at least 2,977 times what was in the soil.

Juncus ensifolius (a rush) accumulated 781 times the amount of zinc in the water and 2.11 times the amount in the soil. Copper accumulated at 2,962 times the level in the water, and 1.42 times the amount available in the soil.

Poa interior (a grass) accumulated copper, zinc and lead. Copper was accumulated at 9,056 times what was in the water, and 4.34 times the amount in the soil. Zinc was accumulated at 2,128.74 times the amount in the water, and 5.7 times the amount in the soil. Lead was accumulated at 5,347 times the amount in the water, and at least 2,674 times the amount in the soil.

Mycology:

Pacific Mine: Microhabitat samples A-C were predominantly silty to sandy and were orangish in color. Microhabitat samples D-J were high in partially decayed organic matter and were dark brown in color. No growth occurred on the 1000 ppm copper-amended medium. Growth was slow but with many colonies on the 100 ppm copper-amended medium. Growth was so profuse on the 10 ppm medium at the 1:100 dilution that separation of colonies for counting and picking for most of the different soil samples was impossible. Three species were isolated from the 100 ppm P-D-A copper-amended tube slants and were identified. There was an average of 39.3 colonies/plate on the 100 ppm copper-amended Martin's medium. The dominant species is an undescribed *Penicillium*. The description is being developed by Christianson and Tuthill. They are presently characterizing it as *Penicillium* sp. nov. "A", and have also discovered it in iron rich mine tailings. Its frequency was 78% (Table 1). Another undescribed *Penicillium* (sp. #1) from the raistickii series was present, along with *P. janthinellum*. Quantitative analysis of the fungi showed that it accumulated an average of 1572 ppm of copper. The liquid medium in which the fungi was grown showed no drop in copper in solution during the duration of the experiment. It is felt that this is an artifact resulting from dehydration of the medium. Quantitative analysis for copper is going to be repeated.

Table 1. Average colony counts and frequency of identified and unknown species from Pacific Mine growing on 100 ppm Martin's Medium.

	<i>Penicillium</i> sp. #1	<i>Penicillium</i> janthinellum	<i>Penicillium</i> sp. nov. "A"
Colony counts	4	4	28
Frequency	11%	11%	78%

Table 2. Analysis of fate of copper in potato-dextrose shake cultures amended with copper and inoculated with dominant species of fungi from the Pacific Mine.

Rep #	Sp.	Site	ppm Cu pre	ppm Cu post	Dif.	% dif.	g. fun.	ppm Cu fun.	pH med aft
10		PM1	84	83.5	0.5	1%	.517	1655	3.4
11			82	82	0.0	0%	.513	1541	3.3
12			82	84.5	-2.5	-3%	.507	1519	3.2

Rep # = Replicate #; Sp. = Species; Site = Site where species was collected; ppm Cu pre = original parts per million of copper in solution before inoculating with the fungus; ppm Cu post = parts per million of copper after nine days of fungal growth in the shake culture; Dif. = ppm Cu pre - ppm Cu post; % dif. = (dif./ppm Cu pre)100; g. fun. = grams dry weight of fungus used to analyze ppm Cu in the fungus; ppm Cu fun. = parts per million of copper in the fungus; pH med aft = pH of the medium after 9 days of fungal growth; Con. = control with no fungus added.

Microsite Code: PM2

UT : Utah County. Pacific Mine swamp (T3S R3E S22). See PM1 for directions. This microsite is the beaver pond where the seep feeds in.

Habitat and Community Information:

This site is located in a valley bottom in a marsh. The elevation is 7,800 ft. The slope is east-facing. Lighting is full.

Basic soil and water chemistry:

pH of Water: 7 Soil pH: 7 N: 5ppm P: 50ppm K: 60ppm

The dominant species is Carex rostrata (a sedge), and Equisetum arvense (a horsetail) is subdominant. Two species were sampled by quadrat on this site.

Individual Species Information:

Chem Code: PM2CR

Species: Carex rostrata

Date collected: 07/31/91

Vigor: exceptionally vigorous Cover: 91 % Frequency: 100%

Chem Code: PM2EA

Species: Equisetum arvense

Date collected: 07/31/91

Vigor: vigorous Cover: 9 % Frequency: 20 %

Heavy Metal Chemistry (mg/kg):

Plants:

Date:	07/31/91	Code:	PM2CR	<u>Carex rostrata</u>	
Cu	Zn	Cd	Pb	Hg	As
102	1309.5	10.71	149.35	<5	47.3

Date:	07/31/91	Code:	PM2EA	<u>Equisetum arvense</u>	
Cu	Zn	Cd	Pb	Hg	As
179	4079	49.7	265.9	<5	93.7

Soil:

Date:	07/31/91	Code:	PM2S	Pacific mine beaver pond	
Cu	Zn	Cd	Pb	Hg	As
28.16	545.96	23.79	29.24	<.2	.5

Water:

Date:	06/25/91	Code:	PM2W	In beaver pond.	
Cu	Zn	Cd	Pb	Hg	As
.14	3.64	.04	<.1	<.1	<.1

Carex rostrata (a sedge) and Equisetum arvense (a horsetail) both accumulated zinc from the beaver pond. Carex rostrata accumulated 360 times the amount of zinc in the water, and 2.4 times the amount in the soil. Equisetum arvense accumulated 1,121 times the amount of zinc in the water and 7.5 times the amount of zinc in the soil. It also accumulated 6.4 times the amount of copper in the soil and 1,279 times the amount of copper in the water.

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Appendix C

"Preliminary Survey of Water Quality in Mine Drainage In Sheeprock Mountains and North Fork of the American Fork River", Merritt, James B., Provo, Utah, July 1988.

Appendix D

"Year End Report On Mitigation Systems For Hard Rock Mine Effluent In Utah", Culp, Nancy, Et Al, University of Wyoming, May 1992.

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